

Drought and Vulnerability in the Dominican Republic

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I, Mayleen Cabral-Ramirez, declare that the work presented in this research project is my own. Where information has been derived from other sources, I confirm that this has been indicated in my work.

Abstract

The purpose of this study was to offer insights about the importance that governments create specific policies to deal with natural hazards, and make sure that concise reliable information is available to all citizens to diminish their risk and vulnerability.

The methodological design of this study had two stages: collection of data through a survey and examination of survey data against the context of official documents from governmental and non-governmental organizations. Questionnaires were used to collect data. The survey was applied to 600 people over the age of 18 living in the four territorial divisions of Santo Domingo, the capital city of the Dominican Republic.

Comparing the current policies and the four main principles of drought policies placed by UNISDR, the DR is unable to meet all principles. Each priority action and indicator throughout the 2015 Dominican report of the Hyogo framework were determined to be ineffective due to the lack of resources, commitment from governmental departments, and lack of capacity. With evidence of the drought policy program, the DR has policymaking capabilities, but lacks successful strategic capacities for implementation.

In general, even if the DR government does have policies, a high percentage of the population does not trust the government to fully implement and carry out the strategic plan. As the survey results revealed, 56.5% of the people residing in Santo Domingo do not trust the national government in preparing them for natural hazards, and 54.3% do not trust the local government in doing so either. The lack of trust in the government, national or local, in relation to natural hazards could hinder the very purpose of establishing drought policies.

The DR experiences a wide array of natural hazards, but drought has become more imminent in terms of its impact. The “National Action Program against Desertification and Drought Effects” provides strategic frameworks to reduce drought impact. Due to the lack of drought awareness, the Dominican community is more vulnerable and susceptible to the impact of drought. In order to decrease the vulnerability of the Dominican population from drought impact, there needs to be an increase of awareness that leads to the understanding of drought. That creates a more proactive society and therefore a more prepared and resilient community.

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Chapter 1


Introduction

The impact of drought can be devastating for any nation due to a wide range of effects. As in a “dominoes effect”, the physical factors of drought hazard affect agriculture, human health, and other aspects of a community. As a result, this situation derives on severe socio-economic and environmental consequences. Examples of common impacts include water shortage, crop losses, famine, and impacts on human health.

The Dominican Republic (DR) is located in the Caribbean and shares the island of Hispaniola with Haiti. Drought is one of the natural hazards most likely to happen in the DR, and as such it has been selected as a case study for this research project.

It is the purpose of this study to offer insights about the importance of governmental policies to in decreasing the vulnerability of community members from natural hazards, and make sure that concise reliable information is available to all residents as a priority to diminish their risk and vulnerability.

Research Questions

The following research questions were generated in order to determine whether: 1) the Dominican government acknowledge the possible risks of drought and, therefore, have strategies in order to decrease vulnerability, 2) the Dominican people are aware of such policies in order to determine the policy's effectiveness, and 3) the gaps in level of preparedness of the community members. 

Through the following research questions, below, it is possible to explore how the policies may reflect on disaster risk reduction effective implementation to diminish the incurred impact of drought in the Dominican Republic.

1. How effective is the drought policy plan in the Dominican Republic?
2. How aware is the Dominican population of the government's drought policies in the Dominican Republic?
3. How prepared is the Dominican community to reduce drought impact?

Chapter 2

Literature Review

2.1 Drought

2.1.1 Defining Drought

In order to define drought, there are different factors to take into consideration: sociological, agricultural, economic, and political, in addition to meteorological and hydrological. Due to these overlapping systems, there are approximately 150 different definitions, an issue that complicates communication of the risks of drought by governments, organizations, and community (Wilhite, 2000).

As Wilhite (2000) further describes “drought severity is dependent not only on the duration, intensity, and geographical extent of a specific drought episode but also on the demands made by human activities and vegetation on a region’s water supplies. The characteristics of drought, along with its far-reaching impacts, make its effects on society, economy, and environment difficult, though not impossible, to identify and quantify” (p. 7). Wilhite (2000) and Wilhite, Svoboda, and Hayes (2007) emphasize the complexity of the phenomenon of drought and the difficulty of understanding the climatic hazard. Due to this complexity, in 1947, Tannehill coined the term “creeping phenomenon” to describe drought (Wilhite, 2000).

Depending on the indicators used, drought often takes three months of abnormally low rainfall to detect (Lake, 2011). According to Lake (2011) “Droughts arise from a lack of precipitation that is due to the development of stationary or slow-moving weather systems – a subsidence of moisture-depleted, high-pressure air over a region. The development of slow-moving high-pressure systems has been proposed to occur due to two different basic causes – changes in solar activity and sea surface temperature fluctuations” (p. 8).

According to Lake (2011), the numerous definitions can be allocated into two categories: 1) as a natural climatic phenomenon, and 2) as a hazard to human activity. The most common definitions are related to the human impact.

This research aims to examine drought as a phenomenon with natural or human causes affecting economic, social or environmental factors.

2.1.2 Typology

Wilhite and Gantz (1985) categorized drought into five types: meteorological, hydrological, agricultural, and socioeconomic drought. Figure 1, demonstrates the differences and their possible impacts.

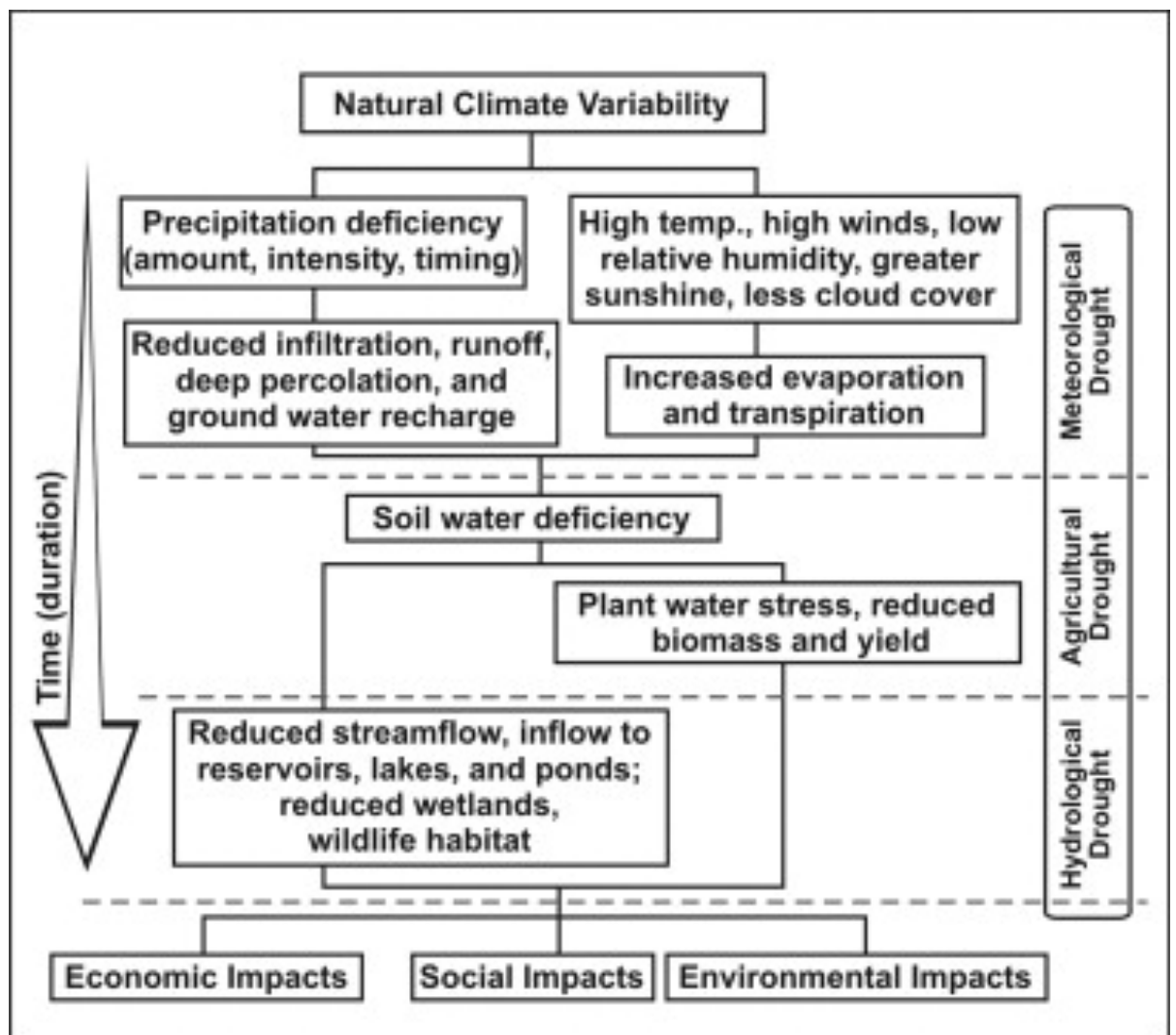


Figure 1. Types of categorized drought (Wilhite, Sivakumar, & Pulwarty, 2014).

2.1.3 Drought impact reduction

The environmental and economic impacts of drought are extensive. It can lead to secondary hazards, such as bushfires. In vulnerable communities, drought can be linked with famine, disease, and social upheaval. This can be seen in colonial India, where two extensive periods of drought caused approximately 12.2 and 29.3 million fatalities, and with a parallel event in China, which killed approximately 30 million people (Lake, 2011, p. 5). To this day, India suffers from the impacts of drought, with around 330 million people suffering from extreme water shortages and crop losses. A high rate of deaths from heatstroke, dehydration, famine, and suicide has been linked to this water scarcity (Delhi, 2016). The catastrophic impacts of these drought events were due to the lack of preparedness among the most vulnerable both in India and China (Davis, 2002).

The effects of drought can be exacerbated due to “inappropriate land use, soil absorption capacity, high temperatures, as well as increased demands for water from the growing population and the agriculture and tourism sectors”, which are all factors experienced in the Dominican Republic (IFRC, 2012). As Wilhite and Buchanan-Smith (2005) point out, although drought cannot be modified meteorologically, the impact on the environment and human society can in fact be modified. Drought, therefore, has both a ‘natural and social dimension’ (Wilhite & Buchanan-Smith, 2005). Lake (2011) further explains that human behavior can influence the response to a drought event “from being hasty and reactive to being well-planned and proactive” (Lake, 2011, p. 4).

One aspect of human response is government’s approach to drought. In Figure 2, Wilhite (1990) demonstrates the cyclical approach of societies and governments to drought and crisis management.

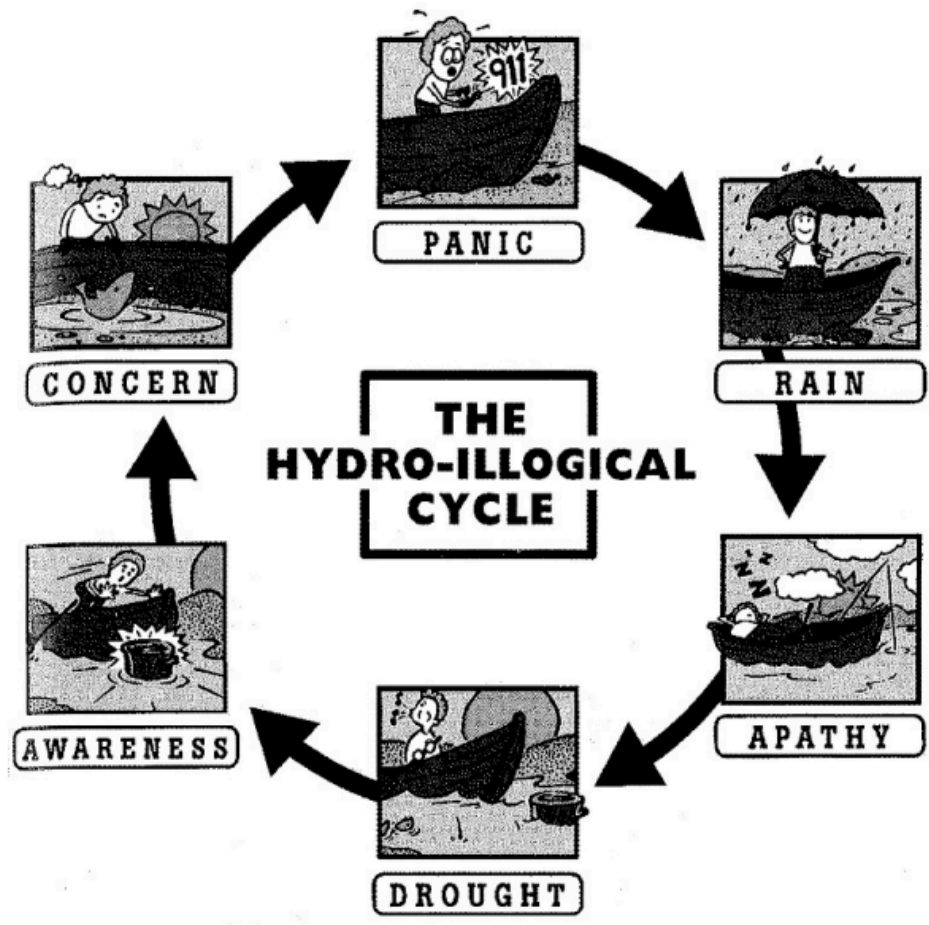


Figure 2. The hydro-illogical cycle illustration that demonstrates the governmental approach to drought and crisis management (Wilhite, 2012 [image]).

2.1.4 Effects of drought

From 2014 to 2015, El Niño-Southern Oscillation (ENSO) impacted weather patterns, particularly in the Americas (i.e. Bolivia, Colombia, and Peru). It was predicted that its outcome would last through spring of 2016 (Gonzalez, 2016).

Cuba, the neighboring island of the Dominican Republic, experienced high impact after the drought of 2015-2016 with a water deficit across more than 25% of its territory. Haiti, the neighboring country of the Dominican Republic, also experienced severe drought conditions in early 2015, which led to food insecurity for approximately 3.8 million people. Humanitarian aid was provided from the WASH/USAID drought projects, ECHO and OXFAM, providing support to Haiti by

“distributing food vouchers, drinking water and seeds, and activating contingency mechanisms through Disaster Risk Reduction Programs” (ECHO, 2015; ReliefWeb, 2017). It was forecasted that through humanitarian assistance, Haiti returned to agricultural stabilization in the summer of 2017. A year after the drought event of 2015-2016 ECHO contributed with 1.1 million euros to cope with the drought impact of 2016 (ReliefWeb, 2017; Dominican Today, 2016).

2.1.5 Drought in the Dominican Republic

National Bureau of Meteorology (ONAMET) research studies show that the ENSO phenomenon has been associated with the most severe droughts in the Dominican Republic (Gonzalez, 2016).

In 2016, after the 2015 drought event, the Dominican Agribusiness Council reported a drop of 25 to 30 percent in dairy production. Production of hydropower (which accounts for 13 percent of electricity in the DR) fell 60 percent, and daily water supply in the Greater Santo Domingo area fell 25% (Gonzalez, 2016).

The Dominican Republic has 34 dams, 20 of them with reservoirs, located throughout the country’s 31 provinces (Gonzalez, 2016; Ministerio de Medio Ambiente y Recursos Naturales, 2012). The priorities of these reservoirs are: 1) household consumption, 2) crop irrigation, and 3) generation of electrical power (Gonzalez, 2016).

In May, the Dominican Republic often experiences higher rainfall but in 2015, there was a deficit in precipitation, which led to an exacerbation of drought impact in drier regions. Based on national and international reports, the Dominican Republic had not experienced such critical drought since 1997, almost a 20-gap year, with a less impactful and apparent drought in 2007. The north experienced the greatest impact, and it was thought that water supplies in reservoirs would be insufficient to supply the region (ReliefWeb, 2016).


Although there were restrictions and advertisements on water shortages during the drought event of 2015 (ReliefWeb, 2016; Gonzalez, 2016), it nonetheless led to losses in agriculture, national water rationing measures, and educational campaigns. Gonzalez (2016) highlights the “importance of educational campaigns on water rationing measures, drought-resistant crops, more frequent technical advice and orientation for farmers, more wells, and the maintenance of available water sources” (Gonzalez, 2016). However, compared to water restrictions, such as those implemented in California, in the United States of America, the government is unable to implement effective restrictions due to the lack of mitigation strategies executed prior to the start of the drought event.

In the regions of Valdesia and Jiguey, there are approximately 70 million cubic meters of water reservoir, which supply, through six aqueducts, the people of the Great Santo Domingo area. However, during the drought of 2015 and 2016, the Dominican water institutions reduced water production to 25% (ReliefWeb, 2016). In order to compensate for water conservation and management strategies, 900,000 gallons of water were provided to the most vulnerable communities (ReliefWeb, 2016).

During the drought of 2015-2016, organizations, such as the Water and Sewage Corporation of Santo Domingo (CAASD), made a point of reaching out to community members and campaigning for water conservation and management (ReliefWeb, 2016), though only during the event. As Wilhite, Sivakumar, and Pulwarty (2014) state, in order to reduce the impact of drought, there needs to be an emphasis on preparedness and mitigation strategies prior to a drought event in order to reduce vulnerability.

2.2 Vulnerability

2.2.1 Defining Vulnerability

The word vulnerability can be defined in many ways. This research focuses on social vulnerability within the field of political ecology, particularly in relation to drought. The definition that best fits the research study is defined by  Brankie et al (2004):

“...the characteristics of a person or group and their situation that influence their capacity to anticipate, cope with, resist and recover from the impact of a natural hazard (an extreme natural event or process). It involves a combination of factors that determine the degree to which someone’s life, livelihood, property and other assets are put at risk by a discrete and identifiable event (or series or ‘cascade’ of such events) in nature and in society” (p. 11).

The potential impacts of a hazard are dependent on societal factors (i.e. socioeconomic indicators, cognition of risk, individual/societal ability to respond) that combine to define levels of vulnerability (Cutter, 1996; Haque & Etkin, 2012). The impact of natural hazards is also based on “society’s concerns, pressures, goals, and risk-related decisions in terms of their effectiveness toward mitigation measures” (Haque and Etkin, 2012). This study will focus on social vulnerability, examining social, political, and economic systems and their interaction with natural hazards, specifically drought.

According to the United Nations Office for Disaster Risk Reduction (UNISDR) (2017), resilience is defined as: “The ability of a system, community or society exposed to hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions

through risk management” (UNISDR, 2017). Thus, vulnerability can be considered an index to resilience by focusing on long-term, rather than short-term mitigation and preparedness strategies. Incorporating local knowledge, skills, determination, livelihoods, cooperation, access to resources and representation can be a holistic approach to increasing resilience, focusing critical resources (i.e. education and training) to provide community members with the necessary tools so they can have and create their own resources in order to mitigate and reduce their own vulnerability.

2.2.2 Vulnerability and Social Awareness and Perception

In order to reduce the impact of a hazard, vulnerability is dependent on the social responsibility of a community. According to Wachinger, Renn, Begg, and Kuhlicke (2013), research has demonstrated that participatory exercises increases awareness and motivates individuals to initiate protective action. This also provides an increase in trusting authorities. Within the same context of social vulnerability, risk perception has influence on reducing risk. Risk perception is closely related to experience, which has an effect on an individual’s preparedness and awareness to various hazards. Moreover, according to Wachinger et al. (2013), there lies a risk perception paradox that is divided into three main factors: direct experience, indirect experience, and trust. Direct experience is that of which an individual experiences an event and the level of their impact, indirect experience is the awareness of the hazard through communication mediums (i.e. social media, news, etc) and lastly, yet, imperative, trust is the link between community members and the government. As stated: “Trust is used as a shortcut to reduce the necessity of making rational judgments based on knowledge by selecting trustworthy experts whose opinion can be considered as accurate. This can result in reduction of the uncertainty, but, due to the fundamental affective dimension of trust (which involves items like honest,

integrity, goodwill, or lack of particular interests), individuals may feel more at risk if their trust in experts is lacking or damaged. Therefore, we see that trust has an important effect on an individual's risk perception" (Wachinger et al, 2013).


Wachinger et al (2013) determined that three general reasons of why there is a lack of connection between risk perception and preparedness is due to: experience and motivation, trust and responsibility, and personal ability. It is further explained that often times the concern is not whether a population is not aware of the natural hazard, rather there are issues that are more imminent – such as poverty, corruption, famine. If looking at it from the psychological perspective, based on Maslow's hierarchy of needs, if people are not provided with the most minimum need to survive on a daily basis, how can they worry about something that may or may not happen? This, however, is an issue that goes beyond risk awareness. Therefore, it must be taken into consideration when creating risk awareness campaigns, trainings, and workshops.

2.2.3 Drought and Vulnerability

According to Stanke, Kerac, Prudhomme, Medlock, and Murray (2013), "The effects of drought are critically dependent on context and underlying population vulnerability. Drought development and severity depend on the background level of water use (which might aggravate drought onset, duration and end) and infrastructure (which aims to mitigate the consequences of water deficit). The impact on health is particularly dependent on the socio-economic environment that can influence the resilience of the population. Poor health, poverty, and conflict are additional contributing factors to the impact of drought...Individual and population vulnerability and resilience factors are critical in exacerbating or mitigating any drought-related impact" (p. 5).

On the other hand, Wilhite et al. (2014) appointed that “Vulnerabilities determined by social factors such as population changes, population shifts (regional and rural to urban), demographic characteristics, technology, government policies, environmental awareness and degradation, water use trends, and social behavior. These factors change over time and thus vulnerability is likely to increase or decrease in response to these changes. Subsequent droughts in the same region will have different effects, even if they are identical in intensity, duration, and spatial characteristics, because the drought event is overlying a society that differs from the one that existed during a prior drought event” (p. 5).

2.2.4 Vulnerability in the Dominican Republic

In the last 5 years, the most frequent natural hazards experienced in the Dominican Republic have been storms, floods, landslides, seismic activity, and droughts (IFRCC, 2012). Previous research have identified high vulnerability from natural hazards in the Dominican Republic, such as flooding and hurricanes. A decade ago, the United Nations Environment Programme (UNEP) determined that the Caribbean region  not meet resilient measures based on the Environmental Vulnerability Index and are “highly vulnerable to natural catastrophes” (Pichler & Striessnig, 2013).

In a comparative study, in which Cuba, Haiti and the Dominican Republic were assessed in their vulnerability from Hurricanes, Pichler, and Striessnig (2013) found that due to the government’s emphasis on education and training for Cuban citizens, their vulnerability levels were much lower than that of Dominican Republic and Haiti. Most specifically in the Dominican Republic, it was found that in the Dominican Republic there was a “lack of... institutionalized long-term prevention plans and both ignorance and indifference at the state level. The data gathered from informants confirmed an inadequate administrative and legislative framework for

risk management and response to disasters...” (Pichler & Striessnig, 2013, p. 6). Thus, the need for socio-cultural liability is dependent on making individuals and community changes in order to decrease the impact of drought through water conservation and management.

2.3 Effective Policy Implementation

2.3.1 Disaster Risk Reduction Policies

Policies identify societal and environmental concerns and determine task-oriented solutions to address national interests (i.e. a more resilient society). Currently, there has been a global focus on disaster risk reduction due to the heightened awareness of natural (i.e. drought, hurricanes, earthquakes, etc.) and anthropogenic (i.e. refugee crisis, terrorism, genocide, civil-war, etc.) hazards impacting millions around the world. Paradigms that delve into reducing hazard vulnerability include: disaster risk reduction, climate change adaptation, environmental management, and poverty reduction. These four research and policy communities consider the *vulnerability* of a community, the *hazards* that may impact the specific area, and the possible economic, social, and infrastructural *consequence* of that community (Thomalla et al., 2006; UNISDR, 2017). According to UNISDR, disaster risk reduction is “aimed at preventing new and reducing existing disaster risk and managing residual risk, all of which contribute to strengthening resilience and therefore to the achievement of sustainable development” (UNISDR, 2017). Therefore, preventative measures are imperative in order to reduce vulnerability in a community.

According to UNISDR (2017), the principles for drought policy are the following:

1. Risk and early warning, including vulnerability analysis, impact assessment, and communication;

2. Mitigation and preparedness, including the application of effective and affordable practices;
3. Awareness and education, including a well-informed public and a participatory process
4. Policy governance, including political commitment and responsibilities

A common trend of different governmental and non-governmental organizations is the striving for a parallel goal, yet through isolation and a non-collaborative approach between research and policy communities, such miscommunication can lead to discourse in achieving similar goals. Developing nations, in particular, require additional assistance in order to reach goals such as sustainable development and disaster risk reduction.

The Hyogo framework for Disaster Risk Reduction of 2005 to 2015 was the first stride toward addressing global disaster risk reduction regulations. This framework has five priority actions:

1. Ensure that disaster risk reduction is a national and a local priority with a strong institutional basis for implementation;
2. Identify, assess and monitor disaster risks and enhance early warning;
3. Use knowledge, innovation and education to build a culture of safety and resilience at all levels;
4. Reduce the underlying risk factors;
5. Strengthen disaster preparedness for effective response at all levels;
6. It has now been superseded by the Sendai Framework for 2015 to 2030.

According to UNISDR (2017), the framework's goal is that through a task-oriented approach "across different timescales and with concrete targets, indicators and time frames...these should be aimed at preventing the creation of disaster risk, the

reduction of existing risk and the strengthening of economic, social, health and environmental resilience” (UNISDR, 2017).

2.3.2 Effective Implementation and the relationship between top-down versus bottom-up approach

There are a variety of challenges to effectively address vulnerability in a society; nonetheless one of the main issues is the lack of collaboration and integration among organizations (Thomalla et al., 2006). Literature repeatedly reveals the need to improve policy implementation. The concept of merging an array of information, knowledge and experience, as well as collaborative work between scientists, practitioners and policymakers from internal and external communities (Thomalla et al., 2006; Wachinger et al., 2013; Gaillard & Mercer, 2012).

As Wachinger et al (2013) explains, risk perception has an effect on risk governance, which is closely related to trust. In order for policies to be effective and efficient, there must be an underlying confidence between community members and authority figures. “Trust in authorities is necessary to build up a social climate in which advice from authorities will be taken into account in a crisis situation” (Wachinger et al, 2013, p. 1061). For policy focused on preparedness and mitigation strategies that relationship is imperative.

As Haque and Etkin (2012) states:

“... the aspects of a community and people’s power to mitigate, improve coping mechanisms, respond effectively, and recover with vigor from environmental extremes are of paramount conceptual and policy importance. Such power of people and communities is embedded in collective efforts and entities (e.g., institutions), which can be harnessed by means of mutual cooperation and partnerships. Because of the ever-increasing human and socio-economic loss caused by environmental disasters and decreasing public

funds to assist mitigation, preparedness, response, and recovery, the significance of partnerships in risk, hazard, and disaster management has risen considerably” (p. 4).

Gaillard and Mercer (2012) further points out that although developed nations provide a top-down approach, through historical context, that same approach has demonstrated that due to the inability to cope alone, developing nations such as Dominican Republic. One of the challenges is due to rooted habits of the community members (Gaillard and Mercer, 2012).

2.3.3 Drought Policy implications

The drought policy process, suggested by Wilhite, provides a step-by-step procedure in implementing an effective framework that incorporates both top down and bottom up approach, risk awareness, science and policy, as well as, the identification of socio-economic factors that can influence the effects of the impact of drought policy implementation.

In relation to disaster risk reduction, the objectives of drought policy follows the same principles generated by UNISDR, Wilhite created a step-by-step procedure that instills the principles, yet breaks down the process in order to effectively implement drought policy.

The ten step drought-planning process as suggested by Wilhite et al. (2014):

1. Appoint a drought task force or committee
2. State the purpose and objectives of the drought mitigation plan
3. Seek stakeholder input and resolve conflicts
4. Inventory resources and identify groups at risk
5. Prepare and write the drought mitigation plan
6. Identify research needs and fill institutional gaps
7. Integrate science and policy

8. Publicize the drought mitigation plan, build awareness and consensus
9. Develop education programs
10. Evaluate the revise drought mitigation plans

In Wilhite's policy process, the first four steps is focused on the integration and collaboration of all stakeholders, determining the process, identifying need areas and vulnerable communities, and compiling data in order to formulate the appropriate drought policy. Step five is the creation of the framework. It must be noted that due to the ever-changing development of new technologies, climate change challenges, and movement of people, the document should be seen as a process and a work in progress rather than inactive one. Steps six and seven are the collaboration of policy maker and scientists in order to improve and develop the framework. Then, steps eight and nine are the dissemination of information to all stakeholders and implementing the actions, and finally step ten is the evaluation of the process and frameworks.

2.4 Dominican Republic

2.4.1 Geography and Environment

The Dominican Republic (DR) is a country located in the eastern two-thirds of the island of Hispaniola. It is the second largest country in the Caribbean (48,921 km²), after Cuba. The DR's topography consists of a diverse range of highland and lowland areas, rivers and lakes, and offshore islands (Ministerio de Medio Ambiente y Recursos Naturales, 2012). Positioned in the natural path of tropical storms, the DR has a long tradition of hurricane and flood vulnerability.

Due to its topography and geographic location, the DR comprises various bio-climatic zones that range from arid (with an average rainfall of 450 mm/year) to very high humidity (with an average rainfall of more than 30,000 mm/year) (Ministerio de Medio Ambiente y Recursos Naturales, 2012, p. 10).

2.4.2 Socio-Economic

With a population size of 10.6 million, with 77% of the population living in Urban areas according to the World Bank, the reliability of water quality and electricity services are low, affecting the key drivers of economic growth – tourism, agriculture, and manufacturing (PreventionWeb, 2017; World Bank, 2017b). The DR has a GDP of 71.58 billion US dollars, with 6.1% focused on agriculture (World Bank, 2017a; World Bank, 2017b). Approximately 53% of the land is used for agriculture, yet only 20% has fertile soil (Ministerio de Medio Ambiente y Recursos Naturales, 2012).

Chapter 3

Methodology

3.1 Introduction

The methodological design of this study had two stages: collection of data through a survey and examination of survey data against the context of official documents from governmental and non-governmental organizations.

The surveys were randomly applied to the residents of the Greater Santo Domingo (Gran Santo Domingo) metropolitan area. The objectives were to determine levels of awareness of Dominican government policies intended to mitigate drought and to understand participants' perception of the risk that they face from natural hazards, particularly drought.

Official documents on laws and regulations were examined to determine whether drought policies exist and are being implemented. Analysis of these documents and comparison with survey data allowed evaluation of the Dominican Republic's government's mitigation and preparedness strategies to reduce the impact of drought.

3.2 Participants

The participants in this research were female and male residents older than 18 years of age living in the Greater Santo Domingo metropolitan area. This region of the Dominican Republic comprises the capital city and three bordering municipalities (Santo Domingo Este, Santo Domingo Norte, and Santo Domingo Oeste)

3.3 Population and Sample

The study groups constituting the population for this study were identified in the IX Population and Housing Census conducted by the Dominican Republic's

National Bureau of Statistics (ONE, 2015). The Census was used to calculate the sample size required to obtain reliable results.

The sample size applied to the research had a confidence level of 95% ($\alpha = 0.05$), which, according to Hernández, Fernández, and Baptista (2006), is considered within the statistical parameters of reliability. To calculate the sample size, the statistical formula presented by Triola (2004) was used. The calculations for determining the sample size for each program are presented in Appendix A.

With a population of 2,688,781 inhabitants in Greater Santo Domingo (ONE, 2012), a sample of 600 people was obtained (Triola, 2004). This sample was divided into four groups, in order to take representative samples from the populations of the three municipalities and the National District which make up Greater Santo Domingo. The following table shows the population and the size of the sample of each area.

Table 1

Sample Size Taken from the Population of the Metropolitan Zone of Santo Domingo, Dominican Republic (Greater Santo Domingo)

City	Population	Sample Size	Percentage (%)
Santo Domingo de Guzmán	965,040	272	45.3
Santo Domingo Este	891,952	143	23.8
Santo Domingo Norte	468,468	53	8.8
Santo Domingo Oeste	363,321	132	22.0
Total	2,688,781	600	100.0

Source: Oficina Nacional de Estadística, ONE. (2012).

Data obtained through the surveys, was recorded in a database and processed using the SPSS statistical package.

3.4 Data Collection Technique

3.4.1 Instruments

Questionnaires were used to collect data. The individuals surveyed were males and females over 18 years old who are residents of the Greater Santo Domingo metropolitan area. The questionnaire included fifty-two questions, of which three were open questions.

Instruments from other research were analyzed in order to create an effective questionnaire.

3.4.2 Instrumental Elaboration

This stage involved the creation of all items or components and/or categories of the instrument, as well as determination of the measurement levels and the coding of items or components, or categories of observation. The instrument used in the present research had five different parts.

Part I: Demographic. This segment of the instrument was comprised of six categories: Age range, gender, marital status, the family monthly income, place that the respondent grew up, and highest level of education.

Part II: Awareness of current policies. Nine questions were related to the respondents' trust in the national government, local government and international organizations to prepare participants for natural hazards, and to the Dominican Republic's policies on natural hazards, water and pollution management.

Part III: Preliminary knowledge of water management. Six questions were related to water consumption in the participants' homes.

Part IV: Technology and preparedness in relation to communication. Eighteen questions were related to the ways of disseminating information and the use of social media, as well as training/workshops for any natural hazard.


Part V: Hazards. Thirteen questions were related to the types of hazards in the Dominican Republic, with a particular focus on drought.

3.5 Procedures

Design. This research aims to provide both a quantitative description of the situation in the Dominican Republic and a correlational exploration of ‘the relationship between variables or the results of variables’ (Bernal, 2006).

3.6 Expected results

This process was expected to produce data to serve as a basis for analysis, as well as proposals for recommendations on aspects that are associated with the risk of natural phenomena that the inhabitants of the Dominican Republic could face, emphasizing the risks of the drought.

One of the most important limitations in the survey was that the sample was made only for the people who are living  in the Great Santo Domingo area. Due to the logistical limitation, it was not possible to survey the whole country.

3.7 Data Analysis

This analytical part was made, based on the attained results, from the product of the application of the instruments that were elaborated, while taking into account, the purpose, objectives with their respective questions formulated in the investigation.

In order to guarantee a high scientific rigor, all of the statistical instruments and relevant methodological assets were used in this part of data analysis. Percentages, measures of central tendency and graphs were used. The methods, inductive, deductive and scientific, both in research, exposure and especially in analysis, were inherent parts of the present work.

The data was analyzed using the SPSS statistics program. Percentages of the answers of all questions were made. The demographic data was crossed with

questions 7 thru 52 (refer to appendix B). In order to present the findings, tables and graphs were elaborated to simplify the findings of the survey.

Chapter 4

Results and Analysis

Three research questions have guided the course of this research. In order to answer them, a data collection process was initiated according to the chosen methodological approach. Responses obtained from a survey, applied between April and May of 2017, were analyzed and all of the information gathered through this mean was linked to sources from the literature review. The survey was applied to citizens in the four territorial divisions of Santo Domingo, the capital city of the DR. Randomly, 600 people over 18 years old participated in this survey.

4.1 Research questions

4.1.1 Results and Analysis for *‘How effective is the drought policy plan in the Dominican Republic?’*

Policy frameworks on risk management encompass international and national protocols. Below, both aspects are considered in order to determine whether the Dominican government provides effective programs to reduce vulnerability risks from drought in the DR. International and national organizations, with additional assistance of NGOs, are led by policies focused on the improvements and maintenance of goals and objectives towards an enriched society.

At the international level:

There are international and non-governmental organizations that target environmental issues in the DR. These include:

1. United Nations Office for Disaster Risk Reduction
2. United Nations Educational, Scientific, and Cultural Organization
3. United Nations Department of Economic and Social Affairs
4. European Union
5. USAID

6. Humanitarian Aid and Civil Protection
7. International Federation of Red Cross and Red Crescent Societies
8. Canadian Development Agency (CIDA)
9. UNDP
10. World Bank

The government has agreed to reach some of its environmental goals by creating proclamations, regulations, and reports based on the following international frameworks:

1. HYOGO framework (based on the last report published in 2015)
2. Sustainable Development goals
3. Millennium Development Goals

At the national level:

National organizations, usually governmental institutions, target different areas of resource and prevention management:

1. Ministry of Environment and Natural Resources [Ministerio de Medioambiente y Recursos Naturales]
2. Dominican Operation Center for Emergencies (COE) [Centro de Operaciones de Emergencias]
3. National Bureau of Meteorology [Oficina Nacional de Meteorología-ONAMET]
4. Corporation of Water and Sewage of Santo Domingo (CAASD) [Corporación de Acueductos y Alcantarillados de Santo Domingo]
5. National Institute of Hydrological Resources (INDRHI) [Instituto Nacional de Recursos Hidráulicos]
6. Ministry of Public Health [Ministerio de Salud Pública]
7. National System for Prevention, Mitigation, and Response to Disasters (PMR) [Sistema Nacional para la Prevención, Mitigación y Respuestas ante Desastres]
8. Civilian Defense [Defensa Civil de la República Dominicana]

Documents:

Several official documents acknowledge the existence of written guidelines on prevention and water management issues. Among them:

1. Dominican Constitution
2. Law No. 147-02 (it provides definition of risk, mitigation measures, risk management descriptions, etc.)
3. Decree No. 275-13: National Plan for Management of Disaster Risk in the DR [Plan Nacional de Gestion Integral del Riesgo de Desastres en la Republica Dominicana]
4. National Plan of Contingency for Hydrometeorological Events [Plan nacional de contingencia para eventos hidrometeorológicos]

On 2000, the Ministry of Environment and Natural Resources of the DR was created. On 2008, this ministry launched the “National Action Program against Desertification and Drought Effects” (known as PAN-LCD). A document describing the program with the same title was published on 2012. Both, the program and the document were developed as a follow up requisite for the DR to join the United Nations Convention to Combat Desertification (UNCCD). Therefore, The PAN-LCD of the DR was created as a mandatory strategic instrument to be signatory of the UNCCD (Comision Nacional de Emergencia, 2015).

Despite the reasons why initiatives and policies are created and under what circumstances, the fact is that DR does have programs, guidelines and written protocols for water conservation management. Official documentation (i.e. constitution, established laws, international agreements, etc.) provides evidence of its existence.

Data from the survey reveals that 49.8% of the participants believe that the Dominican government has not implemented an effective policy to inform the public regarding mitigation and preventative strategies for drought impact. 13.3% affirm

that the DR has implemented effective policies, while 34.2% indicate the possibility of policy implementation. The following table and graph demonstrate the data:

Table 2

Do you believe the Dominican government implements an effective policy that is informative regarding the effects of drought in the community?

Answer	Frequency	Percentage (%)
Yes	80	13.3
No	299	49.8
Maybe	205	34.2
Undefined	16	2.7
Total	600	100.0

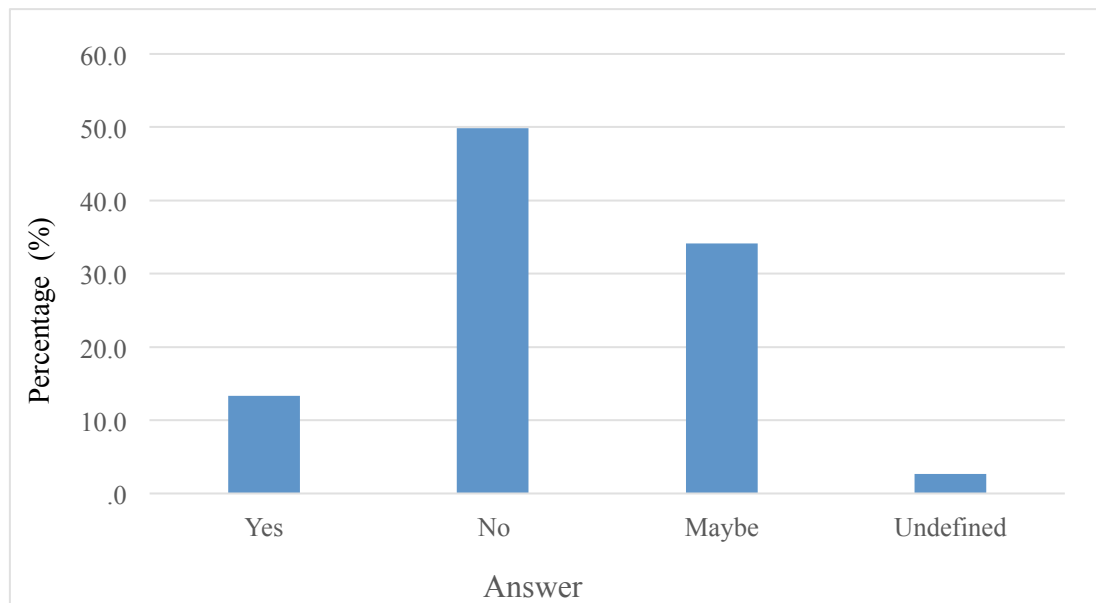


Figure 3. Do you believe the Dominican government implements an effective policy that is informative regarding the effects of drought in the community?

When participants were asked whether they trusted the national government to prepare them for natural hazards, participants appear to not trust the National Government in preparing them for natural hazards, since only 13.8% answered ‘yes’.

However, 56.5% answered that they do not trust the National Government, and 29.7% answered ‘somewhat’.

Table 3

Do you trust the National Government in preparing you for Natural Hazards?

Answer	Frequency	Percentage (%)
Yes	83	13.8
No	339	56.5
Somewhat	178	29.7
Total	600	100.0

When participants were asked whether they trusted the local government to prepare them for natural hazards, participants appear to not trust the local government, since only 15.3% of all of them answered ‘yes’. On the other hand, 54.3% answered that they do not trust the Local Government on this matter, and 29.8% answered ‘somewhat’. Similar answers were obtained when the question targeted the National Government.

Table 4

Do you trust the Local Government in preparing you for Natural Hazards?

Answer	Frequency	Percentage (%)
Yes	92	15.3
No	326	54.3
Somewhat	179	29.8
Undefined	3	0.5
Total	600	100.0

The majority of the participants (94.3%) have heard of the Dominican Operation Center for Emergency.

Table 5

Have you heard of COE (Dominican Center of Emergency Operation)

Answer	Frequency	Percentage (%)
Yes	566	94.3
No	32	5.3
Undefined	2	0.3
Total	600	100.0

4.1.2 Results and analysis for ‘how aware is the Dominican population of drought policies in the DR?’

According to the participants, 38.7% are unaware of current governmental disaster risk reduction policies, while 32.8% state that they are aware of such policies. It is important to note that 28% of the participants stated that they partially are aware of the policies, which means that the mission and campaign awareness within the policies are not effective in terms of disseminating information adequately to the community members.

Table 6

Are you aware of current policies in the DR about natural hazards?

Answer	Frequency	Percentage (%)
Yes	197	32.8
No	232	38.7
Somewhat	168	28.0
Undefined	3	0.5
Total	600	100.0

In terms of the awareness levels for preparedness, which is part of the strategic plan of the general disaster risk reduction policies, and included in the reduction of drought impact program, the majority of the participants have not been

participants of trainings or workshops for possible natural hazard events. This is demonstrated by 68.7% stating that they have not been part of a preparedness training/workshop for any natural hazard from an organization, while 10.2% do not remember.

Table 7

Have you been part of a preparedness training/workshop for any natural hazard from an organization?

Answer	Frequency	Percentage (%)
Yes	125	20.8
No	412	68.7
Do not remember	61	10.2
Undefined	2	0.3
Total	600	100.0

The majority of the participants suggested that the last drought experienced in the Dominican Republic was between last year (2016) with 28.8% and two years ago (2015) with 23.3%, but the most notable result was that 37.5% of the participants does not remember when the last drought event occurred in the last five years.

Table 8

Based on your knowledge, when was the last drought in Dominican Republic?

When was the last drought in Dominican Republic?	Frequency	Percentage (%)
In the last year	173	28.8
Two years ago	140	23.3
Three years ago	34	5.7
Four years ago	15	2.5
I don't know	225	37.5
Undefined	13	2.2
Total	600	100.0

4.1.3 Results and Analysis for ‘How prepared is the Dominican community to reduce drought impact?’

The residents of the Greater Santo Domingo, although demonstrating to have a high level of fear for the incidence of drought (56%), there is still a significant percentage of the population that has little or no fear of drought, which is 40%. This percentage indicates that a substantial proportion of the population does not acknowledge that drought represents a serious threat. Thus, they are not prepared to reduce the impact of drought in the community, unlike those who feel considerable fear to earthquakes (71.7%), floods (62%) and hurricanes (61.3%). With only 8.7%, 12.7% and 6.8% of the population stating they do not have or have little fear to earthquakes, floods and hurricanes respectively.

Table 9

Based on a scale, how afraid are you to the following natural hazards? In Percentages (%):

Natural Hazard	Nothing and Almost Nothing	A little	Much and Too Much
Forestry Fires	28.7	29.0	37.8
Hurricanes	6.8	29.0	61.3
Avalanches	49.8	13.3	25.7
Meteor Shower	45.8	7.0	39.2
Drought	40.0	0.2	56.0
Hail Storms	42.2	22.0	28.7
Earthquakes	8.7	14.7	71.7
Electric Storms	24.3	25.0	45.8
Flooding	12.7	21.7	62.2
Tsunamis	24.2	10.2	60.0
Volcanoes	47.0	7	38.3
Blizzards	56.8	13.3	21.3
Heat Waves	23.8	22	49.0
Tornadoes	33.5	16	44.0

The following graph shows the natural hazards that were analyzed in the survey. It demonstrates how drought is considered as the fifth highest in terms of importance within the participants, so it is assumed that it has a great importance in regard to the fear of the population for it to occur. Only earthquakes (71.7%), floods (62.2%), hurricanes (61.3%) and tsunamis (60%) had higher percentages than droughts (56%).

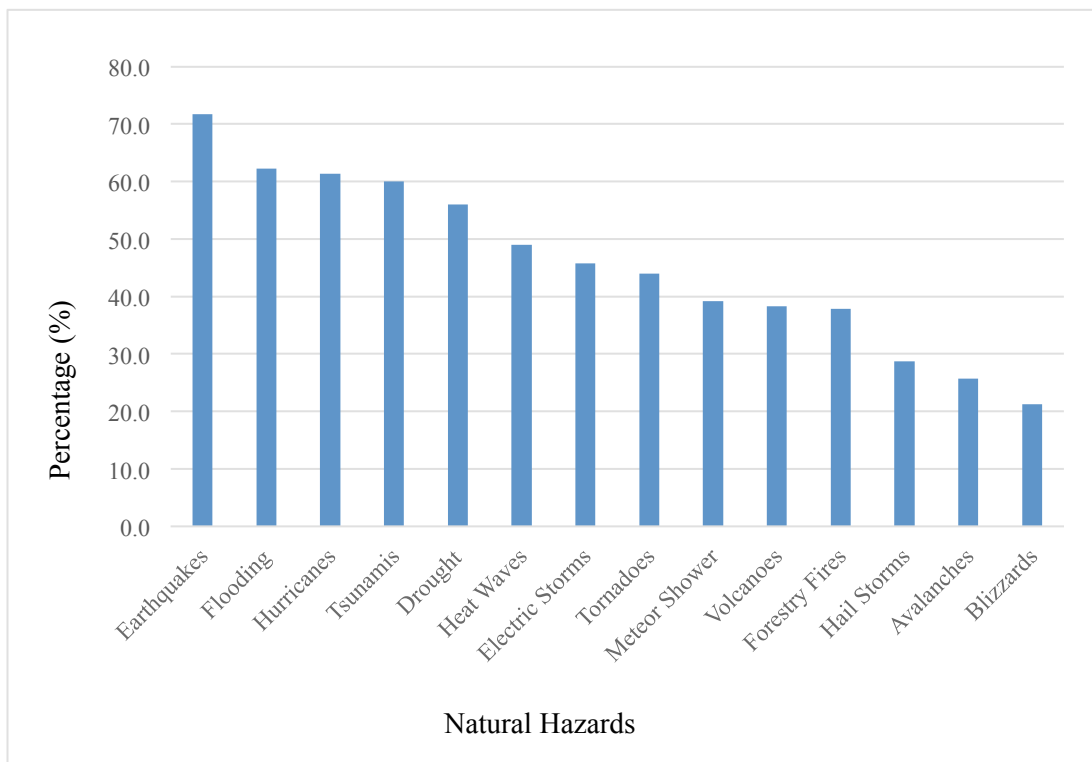



Figure 4. Population of the Greater Santo Domingo who have Much and Too Much Afraid to Natural Hazards 

The following table demonstrates how fearful the habitants of the Greater Santo Domingo area are toward drought, 56% - those who have much fear of drought (37.8%), and those who have too much fear of drought (18.2%).

Table 10

How afraid are the people of the Greater Santo Domingo to Drought?

Afraid to <i>Drought</i>	Frequency	Percentage (%)
Too Much	109	18.2
Much	227	37.8
A little	1	0.2
Almost Nothing	212	35.3
Nothing	28	4.7
Do not Answer	23	3.8
Total	600	100.0

The following figure demonstrates the percentage of the participants in the Greater Santo Domingo area toward their fear of drought.

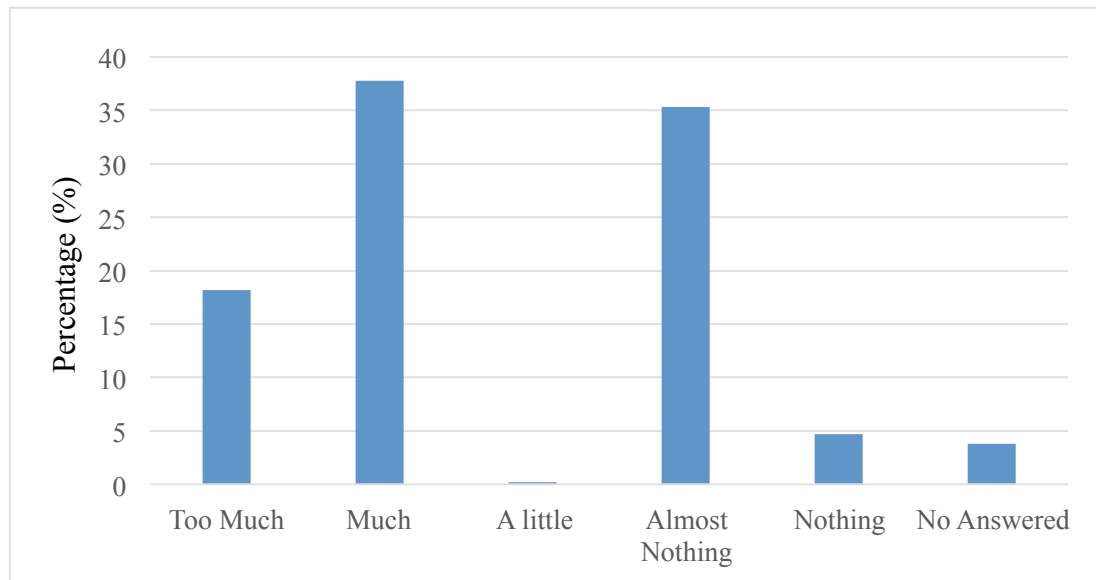


Figure 5. How afraid are the people of the Greater Santo Domingo to Drought?

When participants were asked to define drought, the majority of the participants made reference to meteorological and hydrological types of drought. The

following table ranks the themes based on the most inferences made by the participants.

Table 11

What do you think is drought?

Themes on drought
Lack of water
Dry land
Time period

When participants were asked how drought can impact them, the themes were separated into three categories: economic, environmental and social. It appears as though the participants believe drought has a greater social impact (54.3%).

Table 12

How can Drought Impact you? Categories: Economic, Environmental, and Social.

Economic 37.2%	Environmental 14.2%	Social 54.3%
Agriculture	Animals/plants	Health
Industry	Wetlands	Stress
Tourism		Hygiene
Financial		Recreation
Energy		
Livestock		

Only 11.8% of the participants have participated as emergency volunteers during natural hazard events in the DR, while 87.8% affirmed they have never been volunteers.

Table 13

Have you been a participant as an emergency volunteer in any natural hazard?

Answer	Frequency	Percentage (%)
Yes	71	11.8
No	527	87.8
Undefined	2	0.3
Total	600	100.0

When participants were asked on how to reduce water pollution, the recurring themes are showing in the following table.

Table 14

What are ways to reduce water pollution?

Themes of mitigation strategies to reduce water pollution
Increase awareness campaigns by the government
Decrease corruption
Trainings and preparedness by organizations
Protection of river basins
Increase cleaning operations
Recycling
Education in school
Putting sanctions on factories
Putting sanctions on individuals
Improve forestation
Water treatments
Reduce water consumption
No littering in the rivers/lake

Chapter 5

Discussion and Recommendations

5.1 How effective is the drought policy plan in the DR?

5.1.1. Policy making versus policy implementation

Since 2001, the DR has slowly transitioned toward a more environmentally aware nation with the creation of the Ministry of Environment and Natural Resources. The re-establishment of the constitution in January of 2010, which includes the implementation of Law No. 147-02, and decree No. 275-13; as well as the development of a ‘National System for the Prevention, Mitigation and Responses to Disasters (all combined with established laws, and international reports), provide clear evidence that the DR has gone through the cycle of policy making toward a Disaster Risk Reduction circumspect nation.

In terms of drought policy, in 2008 the Dominican government implemented the ‘National Action Program to Combat Desertification and the Effects of Drought’ per request of the UNCCD, and through its assistance and sponsorship. When comparing the document to the process established by Wilhite et al. (2014), the structure and organization of the document provides the beginning of a strong policy framework. The document provides a scaffold on the implementation plans toward the decrease of drought impact in the DR. Nevertheless, it is important to note that this is a supplementary action plan to the goals of the constitution, laws, and decrees, and not an actual policy. Wilhite et al. (2014) reveals that a nation without an objectively specific drought policy has a higher likelihood to fail in the intent to diminish the future impact of drought.

Another relatable issue for effective policies is the constant discord between theoretical and practical principles (Gaillard & Mercer, 2012; Wachinger et al.,

2013). It is essential to recognize the limitations of policies and their implementations. With evidence of the drought policy program, the DR has policymaking capabilities, but lacks successful strategic capacities for implementation. Many of the challenges it faces are due to the complexity of socio-economic limitations. Such disconnect can be seen through the Dominican reports about meeting the goals of the Hyogo Framework 2005-2015 (Table 15). The recurrent limitations of reaching the Hyogo framework goals are: lack of resources, inability of institutional commitment, and lack of governmental delegation. The biggest challenge for the Dominican government is the lack of resources for increasing awareness (i.e. through mass media and social media campaigns).

In relation to Wilhite et al.'s (2014) 10-step drought policy process, the DR has adequately achieved steps one through seven (i.e. collaboration of stakeholders to integrating science and policy), nonetheless what is impairing the achievement of the program is the most practical aspect and important one: implementation of the policy. Even though the DR has incorporated hydraulic infrastructure through the collaboration of INDRHI and CAASD, one aspect of the policy is the awareness of the community members on improving water conservation and management. As Wilhite et al. (2013) articulates, the purpose of a "...policy is to reduce risk by developing better awareness and understanding of the drought hazard and the underlying causes of societal vulnerability." The main restraint is the lack of knowledge by the people of such program being established, as demonstrated by the participants' response to their awareness of disaster risk reduction policies.

Comparing the current policies and the four main principles of drought policies placed by UNISDR, the DR is unable to meet all principles. Throughout the 2015 Dominican report of the Hyogo framework, each priority action and indicator

were determined to be ineffective due to the lack of resources, commitment from governmental departments, and lack of capacity, as shown below in Table 15.

Table 15

Priority Action and Indicator Determined Throughout the 2015 Dominican Report of the Hyogo Framework

Principles:	Risk and early warning, include vulnerability analysis impact and assessment	Mitigation and preparedness, including application of effective and affordable practices	Awareness and education, including a well-informed public and a participatory process	Policy governance, including political commitment and responsibilities
Limitations:	<u>Priority Action 2, Basic Indicator 3:</u> There are considerable accomplishments, but with recognized limitations like financial resources and operational capacities.	<u>Priority Action 1, Basic Indicator 1:</u> There are considerable accomplishments, but with recognized limitations like financial resources and operational capacities.	<u>Priority Action 1:</u> There are considerable accomplishments, but with recognized limitations like financial resources and operational capacities. <u>Priority Action 2, Basic Indicator 1:</u> There has been institutional commitment, but the accomplishments are not enough.	<u>Priority Action 1 Basic Indicator 2,3,4:</u> There is some progress, but without a political system and/or institutional commitment. <u>Priority action 4, Basic Indicator 2:</u> There has been institutional commitment, but the accomplishments are not enough. <u>Basic Indicator 3:</u> There is some progress, but without a political system and/or institutional commitment.

Source: UNISDR, 2009; Dominican Republic, 2015

5.1.2. The gap between top-down approach and bottom-up approach

The DR has a fortified concept and hierarchical order of law and policy implementation. Nonetheless, there is an absence of positive relationship between top-down stakeholders (government officials, authorities, scientists) and bottom-up approach stakeholders (community members). Due to the top-down, command-and-control, and civil defense disaster risk reduction approach, there lies an inherent gap between the top-down and bottom-up approach when effecting policies. Hence, there needs to be collaboration between all stakeholders through top-down and bottom-up approach, as emphasized by Gaillard and Mercer (2012) and Wachinger et al (2013). Due to the specific localization of drought, there needs to be a focus on local community members as the primary stakeholders in the drought program (Gaillard & Mercer, 2012).

The Dominican government has mitigation and preparedness strategies established in the program, but there is a greater emphasis on physical infrastructures, as demonstrated by dams and reservoirs located in 25 river basins, (Ministerio de Medio Ambiente y Recursos Naturales, 2012). Yet, in terms of social vulnerability, there have been little mitigation strategies effectively incorporated. There are two aspects of the policy: physical and social infrastructures. On one hand, DR has become more water conservation efficient in terms of physical infrastructure through the creation of water dams and improvement of sewage system. However, there is the socio-behavioral aspect that hinders the implementation and effectiveness of a policy. As Wilhite et al. (2014) mentions, social awareness of drought policies is imperative for the decrease of impact of drought. This is due to the social factors that can exacerbate drought impact by the lack of water conservation and management in a local community.

The complexity of a society – historical context, social, and economic factors – can generate difficulty in implementing policy, in particular that which impacts the environment and human behavior. The DR has had difficulty in implementing environmental policies in the past, due to social-economic factors that are more pertinent to the needs of the citizens. “Hence, there is a link between the extent and types of vulnerability generated by people’s conditions within political, social, and economic systems and the manner in which society treats hazards in terms of prevention, mitigation, preparedness, response, and recovery” (Haque & Etkin, 2012).

5.1.3. The relationship between trust and effective policy implementation

Aside from human basic needs, another difficulty the government faces to effectively implement policies is the distrust of the people in the government and authority figures. In general, even if the DR government does have policies, a high percentage of the population (as demonstrated by the study) do not trust the government to fully implement and carry out the action plan. There is a general dissatisfaction with governments in Latin America, due to the processes applied by the stakeholders, and how organizations collaborate and function in a region (Espinal, Hartlyn, & Kelly, 2006; Payne, 2002).

Often, nations have the challenge of connecting policy makers with community members. Something similar could be happening in the DR as the survey results revealed that 56.5% of the people residing in Santo Domingo do not trust the national government in preparing them for natural hazards, and 54.3 % do not trust the local government in doing so either (table 3 & 4). The lack of trust in the government, national or local, in relation to natural hazards could hinder the very purpose of establishing drought policies. Wachinger et al. (2013) argues that if there is too much trust in the government to keep them safe they are more likely not to

take action. However, in terms of drought, mitigation and preparedness strategies are imperative in order to reduce impact. This can be assimilated to the participant's response to whether there are Disaster Risk Reduction policies established by the Dominican government. Part of an effective policy is the information disseminated by the government, and whether this information will be: 1) received by the targeted individuals and 2) the individuals' trust in the information given.

5.2 How aware is the Dominican population of the government's drought policy plans in the DR?

5.2.1 The importance of awareness


Comparing the 10-step process devised by Wilhite, Hayes, and Knutson (2005), steps eight and nine are driven by the importance of the dissemination of information. After policy makers and other stakeholders formulate a framework to diminish the discrepancies between the vulnerability and resilience of a population, the key targeted audience must be made aware of those plans. Otherwise, these strategies will remain stagnant and the goals and objectives of such frameworks will not be achieved.

Having a preliminary understanding on the Dominican awareness levels of environmental policies provides insight on the mechanism and its effectiveness. According to survey participants, less than 33% of the population were aware of current government policies toward natural hazards (table 6), when in fact there are laws, decrees, programs and specific statements in the constitution that infer to regulations toward a more environmentally sustainable and aware society.

5.2.2 Experience and Awareness

Due to the complexity of identifying the onset and culmination of a drought event, as well as the location of the event, these factors affect the experience of a population. Jeffery (1982) explains, "Long term ecological deterioration, for

instance, can be traced to socioeconomic causes but is not so spectacularly visible (except in extreme cases) as the devastation caused by a hurricane. Nevertheless, such gradual deterioration of the resource base of a population implies problems for the future more difficult than those presented in the aftermath of a hurricane. Moreover, the solution of such long term problems may not be given attention by the development agencies and administrators” (p. 38). As Wachinger et al (2013) similarly revealed that direct experience of a hazard has a stronger effect on an individual’s risk perception. For that reason, there is a greater reliability on indirect experience in order to increase the awareness levels of the risks connected to drought.

Nonetheless, one of the major problems in generating an indirect experience in the DR is that drought is not a sudden random event that people are used to experience as in the case of a hurricane , which has more immediate tangible consequences and more frequent incidence. Thus, it is harder to connect the risk with the community members. Especially if individuals do not believe there are related impacts, as further demonstrated by the participant’s response on table 11. Hence, the mindset of the general population and authorities tend to underestimate the impact of drought.

5.2.3 The window of opportunity

In 2017, the agricultural preliminary reports show a normal season with some localized dryness (FAO, 2017). In relation to indirect experience, the Dominican government is not exploiting the window of opportunity in order to create awareness of adaptation strategies to combat drought impact. In 2015, the DR experienced one of the most impactful droughts from a 20-year period. However, based on the survey, only 23.3% of the participants were aware of such drought event (Table 8). But the

most surprising response was that 37.5% of the participant had no awareness of whether or not there was a drought in the past five years.

Something that must be taken into consideration is the limitation factor that can impede the awareness of the policies and events. The trust of the population on the government can hinder the acceptance of information provided by the government regarding action plans that affects the public. The historical context of the Dominican government not fulfilling constitutional regulations has a possible effect on public distrust and awareness levels. The public feels more easily inclined in talking about the government's shortcomings, than their attempt in supporting the people. This is closely related to corruption, as shown by the participants distrust as a common theme on how to reduce pollution (Table 14).

Currently in the DR, mitigation and adaptation strategies range from early warning systems to awareness campaigns. However, even though these strategies exist, the challenge is the awareness level of the population regarding disaster risk reduction strategies.

5.2.4 Awareness and resilience

Risk awareness and perception are key factors in combating vulnerability and enhancing a resilient society. An important aspect of risk awareness is the knowledge of the early warning system process of any natural hazard, especially those that are most frequent in a region. Due to the location of DR it experiences a wide array of natural hazards: hurricanes, earthquakes, tsunamis, and drought. Even with early warning systems and the plans set forth by the PAN-LCD, it seems as though the educational and communication dissemination to the population is not effectively implemented. Although, approximately 94% of the participants affirmed of knowing about the Operation Center of Emergency (COE) of the DR (table 5) - which proclaims to assist through preventative measures and response tactics for possible

hazards in the DR – there seems to be a more reactive response in terms of disaster risk reduction.

For instance, the COE played an important role in instructing the population of the country during recent hurricanes Irma and Maria. Also, the Ministry of Public Work (MOPC for its Spanish acronym), and the Institute of Potable Water and Sewerage (INAPA by its Spanish acronym) made joint efforts for prevention or early intervention as soon as the hurricanes' alert was given. Both organizations activated their respective emergency committees to work before, during, and after these hurricane affect the territory of the DR. The first priority of the MOPC was to maintain the main roads free from debris, so other institutions can also offer assistance and reach the communities in need, while the logistic of INAPA focused on trying to preserve the water quality for human consumption (Rodriguez, 2017).


Therefore, in order to reduce the impact of drought in the DR, there needs to be a symbiosis between the government's goals and the public. Clearly, due to the lack of awareness of the policies, as demonstrated by the response of the participants, there is a lack of awareness of the strategic plans that the Dominican government attempts to implement in terms of drought impact reduction. By not having such information available to the public there lacks a connection between the goals of the top-down stakeholders and the knowledge of the local community.

5.3 How prepared is the Dominican community to reduce drought impact?

5.3.1 Awareness in relation to preparedness

From the social standpoint, the first step toward a more resilient society is the individual's underlying risk awareness and perception that is adequate to mitigate future drought events. Depending how an individual perceives risk will impact how they prepare and respond toward an event. Previously, it was discussed the

implementation of new projects lead to the development of adequate infrastructures (i.e. dams). From the physical standpoint, the Dominican community is prepared to reduce the impact of drought. However, the most important aspect is the community's comportment in relation to the strategies and societal habits. Gaillard and Mercer (2012) make reference of the impediment of bridging the gap between all stakeholders and that is the will to collaborate. If community members do not perceive drought as an imminent risk to their environment and to themselves, the will to collaborate can be a challenge.

In the survey, participants demonstrated somewhat of a high level of fear for drought (56%), yet tsunamis, which have not occurred in the last 20 years, was ranked higher, with 60% of the participants choosing 'much' and 'too much' fear (see table 9). It is fair to state that tsunamis are a tangible and highly sudden impactful natural hazard, but the  of the participants may be related to the recent flash flood that occurred in November of 2016. Such event displaced more than 20,000 peoples and created a direct experience to the Dominican community members (ReliefWeb, 2016)

Not perceiving drought as an imminent hazard, then leads to possible dissonance in collaborating with authority figures. This notion then leads to a vicious cycle of the discord of collaborative strategies to the reduction risk.

5.3.2 Understanding drought definition

If the government is actively implementing mitigation strategies, then there lies an important course of action from the Dominican population in order to meet the national goals. Wachinger et al.'s (2013) findings have lead to determine that humans mostly base their actions on their previous experiences (indirect and direct).

Based on these experiences, the understanding of a hazard is necessary. So, the first step in understanding drought is by having a working knowledge of the risks

at hand. However, in order to detect the gaps within the policies, through a bottom up approach of identifying the community's definition of drought in comparison to the needs of the environment and the population, it can provide an insight to the necessary improvements.

As previously mentioned, risk awareness and perception can hinder the preparedness and response level of a community. In the study, it revealed gaps between knowledge of understanding drought and the related impacts of the participants.

Due to societal conditions changing over time, the impacts of drought vary based on the interplay between "a natural event (precipitation deficiencies because of natural climatic variability) and the demand placed on water and other natural resources by human-use systems" (Wilhite et al., 2007). This leads to the complexity understanding the risks of drought and therefore having a universal definition.

This is apparent as the participant's concept of drought was focused on: lack of water, dry land, and time. These themes are closely correlated to meteorological and hydrological types of drought. The exclusion of agricultural and socioeconomic descriptors can infer disconnect between the hazard and its possible impacts.

This leads to the challenge of implementing policies and strategies due to misunderstanding of the concept of drought, which can lead to lack of preparedness of the individuals. This is an apparent challenge, as a result of the participants having a generalized perspective on the definition of drought. Therefore, in understanding the definition of drought in relation to preparedness levels, the Dominican community is not prepared to reduce drought impact.

5.3.3 Understanding the impact of drought

The second step to reducing vulnerability is the understanding of the impact of drought and its cascading effects through agricultural, hydrological, economic,

environmental and social systems (Wilhite et al., 2007), in other words, the conceptualization of hazard and consequence as a mutual interaction to reduce vulnerability.

When participants were asked to provide their perception on the possible consequences of drought, the three themes fell in terms of economic, environmental and social impacts, these categories were also suggested by Wilhite et al (2005) in their ‘checklist of historical, current and potential drought impacts’.

Based on the participant’s response, there is a greater implication to social impacts (table 12). Most specifically, personal hygiene is extremely important when addressing drought impact. It appears as though participants value the water availability in terms of their daily routine as demonstrated by the recurrent theme on the inability to shower, wash the car, clean the house, and wash the dishes.

As for the economic aspect on the consequences of drought, participants made a greater inference to agricultural impact, nevertheless it was often paired with health, in relation to the inability of having enough food.

It seems as though there is a discord between the participants and their environment, with 14.2% making inference of drought having an impact on the environment. It is important to note that this disconnect may explain the lack of awareness of participants possible social responsibility in the outcomes of the environmental issues (i.e. pollution). There are multiple theoretical frameworks that explain the possible gaps toward positive behaviors toward the environment, such as recycling (Kollmuss & Agyeman, 2002). The fact of the matter is that the Dominican perception of the environment is disconnected to their livelihoods. Although there is an understanding that drought can impact their livelihoods, there is a discord between the social behaviors impacting the environment’s well being.

5.3.4 Water conservation and management practices


The relationship between the understanding of a hazard and its impact often leads to an action, whether positive or negative. Human habits have an impact on the vulnerability incurred by a possible risk. The government has a strong influence in leading a nation to the improvement of societal deficits in relation to economic, environmental and social factors; however, the local community members have the strongest influence

The behavior and habits of a community makes an effect on the success of policy implementation, for that reason “quality matters in the implementations; it ensures that we attend much to the means of public service delivery as the ends” (Sandfort & Moulton, 2014, p.15). By asking the participants on whether they have participated in volunteering or training postulates a sense of public service within disaster risk reduction. From the 600 participants, 11.8% only participated as a volunteer during a natural hazard, while 87.8% affirmed that they have never been volunteers (table 13). This demonstrates a lack of public service within the community, in terms of collaboration with authority figures.

It is important to note that, whether or not people are aware of the possible strategies, there are still pertinent issues in meeting the basic needs of the population, and consequently this leads to the possible lack of social responsibility. Therefore, are individuals taking responsibility in order to improve their society? When addressing strategies to reduce water pollution, participants seem to not connect to a direct personal responsibility in diminishing the impact of environmental issues (Table 17).

As a result of these findings, recommendations have been formulated to decrease the gap.

5.4 Recommendations

Due to the lack of understanding of the concept of drought, its possible impact and preparedness strategies,  the community members of the DR need to further improve on the awareness levels of both the policies and the understanding of risks in relation to drought impact. These recommendations are also linked to the strategies suggested by the participants.

5.4.1 Education

Awareness Campaigns. Acknowledging that the DR community members experiences societal limitations that are more vital to their quality of life (i.e. poverty), there needs to be an increase in reaching out to the most vulnerable communities and increasing the awareness level by making an emphasis of the importance of water conservation and management and the possible impacts related to other pertinent societal factors (i.e. nutrition). Provide constant communication through news outlets (i.e. television, newspapers) in order to increase the awareness levels through reputable sources in which the population trusts. When informing the public of the political strategies, the following must be taken into consideration: the key targeted audience, education level of the audience, what are the means of communication, and the inclusion of the local knowledge.

There needs to be an emphasis in communicating with community members of the socio-economic and environmental impacts of drought. As suggested by the participants, there more awareness campaigns to inform the general public. Through the proper use of social media (i.e. Instagram, Facebook, Whatsapp, etc) and the inclusion of environmental segments in the news that further informs on hazards and their impacts in the Dominican Republic.

Educational framework. Although, after the event of 2015, authorities and government officials were more welcoming of the scientific community, as

explained by Gonzalez (2016), it is recommended that in order to increase individual social responsibility, there needs to be a reform in the educational curriculum to include a framework that delves into disaster risk reduction. This has an impact on the understanding of natural hazards, especially drought, which is a multi-dimensional hazard, and is experienced in the DR. The framework should include: hazards that impact the world, with an emphasis on Dominican Republic, the importance of water conservation and management, doing fieldwork to encourage public service, provide more scientific knowledge, and increase the partnership of organizations that work in the field.

5.4.2 Sanctions

While the participants made an emphasis on sanctions to factories that pollute the waters in the DR, the Government should also implement legal regulations in water conservation and management. These sanctions can be regulated through water control and monitoring systems, similar to how electricity is monitored. It is important to note that these sanctions need to be explained by the government for there to be an understanding of why these are being implemented. It provides trust from the government to the people. However, it is important to note that this suggestion may increase drought susceptibility by inflicting socio-economic sanction on the most vulnerable.

5.4.3 Reducing the gap between top-down and bottom-up approach

Based on the participant's response of trusting the government and ways in reducing water pollution, corruption was an indication of the gap between the top-down and bottom-up approach. In which case, the government needs to build trust with the community members in order to have a symbiotic relationship. These can occur through the previous recommendations – education and sanctions.

5.5 Limitation

It would be interesting to see how the population ranks the need in society, where does environment and disaster risk reduction lie?

The study was done in the Santo Domingo area, and it would be necessary to consider the perspective of those living in rural areas where drought can have a more direct effect.

Lack of infrastructure might impede proper regulations to be applied. As an example, the CAASD has no control of household water usage, and low-income neighborhoods connect to pipelines illegally. Therefore, applying sanctions for wasted water misuse will be difficult to apply.

Research questions for further investigation

Throughout this study, further research questions arose:

1. How is disaster risk reduction implemented from the educational level?
2. How do societal factors in the Dominican culture impact preparedness level for disaster risk reduction?
3. How can pro-environmental behavior be encouraged in the Dominican community?

Chapter 6

Conclusion

The DR experiences a wide array of natural hazards, but drought has become more important in terms of its impact. The “National Action Program against Desertification and Drought Effects” provides strategic frameworks to reduce drought impact. However, policies on Drought are often disguised as water management strategies, rather than a clear set of regulations for people to follow. Due to the lack of drought awareness, the Dominican community is quite vulnerable and susceptible to the impact of drought. In order to decrease the vulnerability of the Dominican population from drought impact, there needs to be an increase of awareness, that leads to the understanding of drought, that creates a more proactive society and therefore creates a prepared and resilient community.

Appendices

Appendix A

Sample Size Calculation

The formula presented by Triola (2004) was used in order to determine the sample size (n) to answer the questions formulated in the present investigation. This mathematical formula takes into account the following statistical variables: a) population size (N), b) probability of occurrence of the event, commonly called success, c) probability of not occurring the event or failure, D) the statistic Z for a level of significance of 95%, and e) the sampling error.

Sample size formula (Triola, 2004):

$$n = \frac{N \cdot p \cdot q \cdot [Z_{\alpha/2}]^2}{p \cdot q \cdot [Z_{\alpha/2}]^2 + (N - 1) \cdot E^2}$$

n = Sample size

N = Population size

p = Estimate Proportion (probability of success)

q = 1 - p

z = Statistic z value for a Confidence level of 95%.

α = Significance level (5%)

E = confidence interval (also called margin of error)

Procedure. The data used were:

N = 2,688,781

p = 0.5 (50% as the worst)

q = 1 - 0.5 = 0.5

α = 5% (0.05)

Z_{α/2} = 1.96

E = 4% (0.04)

$$n = \frac{2,688,781 * (0.5) * (0.5) * [1.96]^2}{(0.5) * (0.5) * [1.96]^2 + (2,688,781 - 1) * (0.04)^2}$$

$$n = \frac{2,582,305.27}{4,303.01}$$

$$n = 600$$

Appendix B

Survey Questions

Thank you for agreeing to take part in this important survey which will be used in a Masters' Thesis in Risk Management and Resilience about measuring the community belief toward the environmental situation in the DR. Your opinions will have the objective to improve the community. This survey should only take between 10 to 15 minutes of your time to complete. Be assured that all answers you provided will be kept in the strictest confidentiality.

I. Demographic

1. Age range

18-22 23-27 28-32 33-37 38-42 43-47
48-52 53-57 58-62 63-67 68+

2. Gender

Male Female

3. Marital Status

Single Married Divorced Widow Free Union

4. In Dominican pesos, what is your family monthly income?

0 -10,000 10,000 – 20,000 20,000 – 30,000 30,000 – 40,000
40,000 - 50,000 50,000 – 60,000 60,000 – 70,000 70,000 – 80,000
80.000 - 100,000 100,000 – 150,000 150,000 – 200,000 200,000 +

5. Where did you grow up?

Capital – Santo Domingo Eastern Region Cibao Region
Northwestern Region Southern Region Northeastern Region

6. What is your highest level of education?

No schooling Elementary School High School Some college
Technical degree College degree Masters Doctoral (Dr/PhD)

II. What do they know about current policies?

7. Do you trust in the national government to prepare you for natural hazards?

Yes No Somewhat

8. Do you trust in the local government to prepare you for natural hazards?

Yes No Somewhat

9. Do you trust in international organizations to prepare you for natural hazards?

Yes No Somewhat

10. Do you trust in your neighbors to help you when affected by natural hazards?

Yes No Somewhat

11. Are you aware of current policies in the DR about natural hazards?

Yes No Somewhat

12. Based on your personal knowledge, what types of pollution are in the DR?

Water Air Light Radioactive
Soil Noise Thermal

13. Based on your personal knowledge, Are there current policies toward pollution management in the DR?

Yes No Somewhat

14. Based on your personal knowledge, Are there current policies toward water management?

Yes

No

Somewhat

15. Based on your personal knowledge, What are ways to reduce water pollution?

III. What do they know about water management?

16. How much do you spend on water in your home?

Too Much

Much

A little

Almost Nothing

Nothing

17. Do you take?

Showers

Baths

Both

18. How long do you shower in the day?

0-10 minutes

10-20minutes

20-30 minutes

30 o más minutes

19. What kind of this household appliances do you have in your home?

Dishwasher

Washing machine

Garden/Lawn sprinklers

Others _____

20. What kind of water reservoirs do you have in your home?

Water cistern

Water tank

Water Barrels

Others _____

Jacuzzi

Pool

Water Fountains

21. How many flushable toilets does your house have?

One

Two

Three

Four

More than Four

None

IV. Best ways to prepare them (technology): Communication

22. Do you own a cell phone?

Yes No

23. Do you have a consistent number?

Yes No

24. What types of social media do you use? Check all that apply.

Vine Instagram Facebook Google+ Pinterest Tumblr

Twitter Snapchat LinkedIn YouTube WhatsApp Others _____

25. Do you use WhatsApp?

Regularly Sometimes Never

26. Have you received any current information about environmental issues in the DR through e-mail?

Yes No

27. Have you received any current information about environmental issues in the DR through social media?

Yes No

28. How often do you open your e-mail?

Regularly Sometimes Never

29. Would you open and read information from the government if it were sent through e-mail?

Yes No

30. Through what medium would you prefer receiving information from the Government about environmental issues? Check all that apply:

e-mail WhatsApp Mail Radio
Television Newspaper Social Media

31. You inform relatives or friends about current political issues through: Choose all that apply:

e-mail Social media Text Messages Phone Call

32. You inform relatives or friends about current environmental issues through? Choose all that apply:

e-mail Social Media Text Message Phone Call

33. What is the best way to receive information?

Text Message Television Newspaper Magazine
Phone Call Social Media e-mail Radio

34. Have you been part of a preparedness training/workshop for any natural hazard from an organization?

Yes No Do not remember

35. During your schooling, were you taught about water management?

Yes No Do not remember

36. Have you seen advertisements about trainings or workshop to prepare for natural hazards?

Yes No

37. Have you heard of Red Cross or USAID?

Yes No

38. Have you heard of COE (Dominican Center of Emergency Operation)?

Yes No

39. Have you been a participant as an emergency volunteer in any natural hazard?

Yes No

If yes, which natural hazard and when? _____

V. Hazards

40. What type of hazards does the DR experience? Check all that apply:

Hurricanes Earthquakes Drought Electric Storms Heat waves
Avalanches Tornadoes Blizzards Hailstorm Forestry Fires
Flooding Tsunamis Volcanoes Meteor shower
Others _____

41. According to your acknowledgement, which hazards are the most uncommon?

Hurricanes Earthquakes Drought Electric Storms Heat Waves
Avalanches Tornadoes Blizzards Hailstorm Forestry Fires
Flooding Tsunamis Volcanoes Meteor shower
Others _____

42. What do you think is drought? Define.

43. How can drought affect you? Explain

44. Based on your knowledge, when was the last drought in DR?

In the last year Two years ago Three years ago Four years ago I don't know

45. Have you seen advertisements about drought?

Yes No

46. If yes, where have you seen advertisements about drought?

School Television Newspaper Magazine
Working Place Others ¿Where? _____

47. Have you been directly affected by drought?

Yes No

48. Have relative(s) or friend(s) been directly affected by drought?

Yes No

49. Based in Social Aspects, What is the probability or intensity of the effects of drought in your community?

High Medium-High Medium-Low Low

50. Based in Economic Aspects, What is the probability or intensity of the effects of drought in your community?

High Medium-High Medium-Low Low

51. Do you believe the Dominican government implements an effective policy that is informative regarding the effects of drought in the community?

Yes No Maybe

52. Based on a scale, how afraid are you to the following natural hazards?

	Too Much	Much	A little	Almost Nothing	Nothing
Forestry Fires	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hurricanes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Avalanches	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Meteor Shower	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Drought	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Hail Storms	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Earthquakes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Electric Storms	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Flooding	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tsunamis	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Volcanoes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Blizzards	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Heat Waves	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Tornadoes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

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