



NEAR EAST UNIVERSITY
GRADUATE SCHOOL OF APPLIED SCIENCE
DEPARTMENT OF CIVIL AND ENVIRONMENTAL ENGINEERING

**THE IMPACTS OF FLOODING ON HEALTH IN PAYNESVILLE, JACOB'S
TOWN COMMUNITY**

M.Sc. THESIS

Burton DORLEY

Nicosia
June, 2022

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Supervisor

Assoc. Prof. Dr. Fidan ASLANOVA

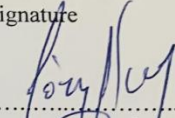
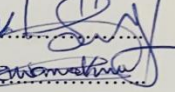
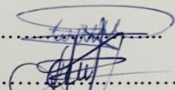
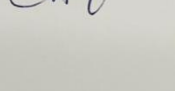
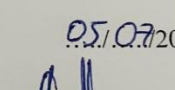
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June, 2022

Approval

We certify that we have read the thesis submitted by Mr. Burton DORLEY titled "The Impacts of Flooding on Health in Montserrat, Jacob's Town Community" and that in our combined opinion it is fully adequate, in scope and in quality, as a thesis for the degree of Master of Applied Sciences.

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Declaration

I hereby declare that all information, documents, analysis and results in this thesis have been collected and presented according to the academic rules and ethical guidelines of Institute of Graduate Studies, Near East University. I also declare that as required by these rules and conduct, I have fully cited and referenced information and data that are not original to this study.

Burton DORLEY

...../...../ 2022

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First of all, I am grateful to the Almighty God for his guidance through this work, and also to Assoc. Prof. Dr. Fidan ASLANOVA and Prof. Dr. Gözen ELKİRAN for the insightful comments and making clarity to this research work. This appreciation is also extended to the courses tutors, for the level of capacity building throughout the years of study. As well as the administrators Graduate School of Applied Science and of the Environmental Science Department for making us to realize the aesthetic of this program thereby contributing immensely to the environmental sector and impacting lives.

To all the residents in the Jacob Town Community, I want to thank and appreciate all of them for giving me much information needed to do this work and also happy that the Administration of the Environmental Protection Agency, the National Disaster Management Agency for giving all the needed books and knowledge to do this work.

Burton DORLEY

Dedication

This research Study is wholeheartedly dedicated to my beloved parents and guidance, who have been the source of my inspiration and for providing me the courage when I thought of giving up, and for continually providing their moral, emotional and financial support.

I would like to dedicate this research work to Mrs. Oretha Y. Dorley and Mr. & Mrs. Amos G. Young. I also dedicate this work to the Near East University, Department of Environmental Science & Engineering, for making me to understand the meaning of this study and how we can contribute to society. And lastly, I dedicate this work to the Almighty GOD for giving me the light and guide in doing this study.

Abstract

The Impacts of Flooding On Health in Paynesville, Jacob's Town Community

Burton DORLEY

M.Sc., Department of Civil and Environmental Engineering

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The aim of this work is to identify the health hazards associated with the impacts of flood in the Jacob's Town community, which is very helpful to all, supporting one of the sustainable development goals. In this work, data will be collected through interview questionnaires and analyze to get tangible findings as a result of finding solutions to the problem.

Right around 90% of the populace is inhabiting danger because they reside within areas that are flood prone. During the raining season in Liberia, which has its peak within June and August, the Jacob's town community is highly affected because people are not able to leave their house to go out. The extreme weather introduces many sickness and diseases such as malaria, typhoid and cholera. Liberia experienced which is a universal hazard because of heavy rainfall seasonally. Flooding in the Jacob's town community is more due to poor drainage and improper land use and this work focuses on the health impacts, taking into consideration the major push that leads to flooding, the citizens were not aware of the impacts that flooding has and upon the hit, many of them were devastated.

This work shows that, because of the increasing rainfall, and the constant introduction of different diseases and other issues that may arise as a results of poor waste management, affects human well-being a lot and because of that solutions and recommendations were made based on the findings of the data collected and conclusions were drawn.

Key Words: flooding; catchment; climate change; rain gauge; temperature.

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List of Abbreviations

DGPC: Directorate General of Civil Protection

EPA:	Environmental Protection Agency
MCC:	Monrovia City Corporation
MPW:	Monrovia Public Works
GIF:	Global Environment Fund
LWSC:	Liberia Water and Sewer Company
UNSC:	United Nations Security Council
WHO:	World Health Organization

CHAPTER I

Introduction

Flood is however considering as a natural disaster, which can be very deadly causing migration, introduction of other species and moreover lack of poor health. This was conducted in Jacob's Town, Paynesville city.

In this community, the community dwellers build their houses in the wetlands, because of poverty increase and lack of land space. The community dwellers also put their household waste, either in the drain-ages or the water ways, which is very bad and poses threat to human's health and the environment.

In the past ten years, there have been a record amount of floods in Liberia, one of the wettest countries in the world.

Communities in Lower Jacob's town, which have experienced flooding on multiple occasions over the past four years, continue to be at risk of flooding, especially during the wettest part of the year. The National Disaster Management Agency claimed that around 15,000 people were affected by floods in 49 communities of Jacob's town, in late June and early July 2016. Urban areas in Montserrado are among the most hit, with nearly 45% of the population affected.

The Du River, which empties into the Atlantic Ocean in Lower Margibi, overflowed its banks once more, putting the residents of those communities in danger.

In order to find the problem of which the community face in terms of flooding impacts, this research project was deemed necessary, thereby collecting data and making a closure of the findings as it relates to the impacts that flood has on the human's health.

Figure 1:

Map of the Jacob's Town Community (nona.net)



Problem Statement

The rate of Flooding has been remarkably high in Liberia. It is estimated that over 90 percent of the heavy rainfall in Liberia causes flooding greatly. In most cases the available statistics on flood don't really tackle local community. Floods could be caused due to natural causes or human activities. It is caused by discharge of huge volume of water in a short span of time, at the rate such that the water cannot be carried away from the scene of discharge.

In Liberia, most especially the area of which this study covers, is highly affected by flooding impacts because of the increase in different health problems ranging from malaria, typhoid, to that of cholera, there is a need to address this problem for the good and healthy well-being of humans and the environment.

According to the front-page Africa news, the figure 2 shows how the impacts of flood is very devastating making the householders not to be able to move or sleep freely and most often the water hits the roof level. (front-page Africa 2021).

Figure 2:

Flooding impacts, in Jacob's Town Community on Sept. 3, 2021 (front-page Africa 2021)



Study Aim

The study objective of this work is to identify the health impacts of flooding in the Jacobs Town Community, Monrovia Liberia, and using interview questionnaires as data collection source and getting results. The aim of the study will be achieved by the following objectives:

- To investigate the rate of waterborne sickness within the community of the research study over a period of time from 2012 – 2022.
- To assess if the community has proper drain-ages channel that can control water
- To collect data from community dwellers about their flood experience

Research Questions

- To what extent has flooding been witnessed in Jacobs Town, Greater Monrovia and the causes?

- What are the negative impacts of Flood?

Significance of the Study

According to the 2009- population census, the Jacob's town community consists of 9,669 including men women and children (UN national data, 2020). (Ajose A, 1974). About 32% of the national data in this area are involved with businesses, 26% government workers, 35% unemployed (youth) and 7% are students.

The importance of this project is to come up with tangible findings, taking into consideration past occurring events of flood cause in the Jacob's Town community. After the findings, we will however continue to pursue community dwellers through awareness programs, the Government of Liberia line Ministries and Agencies that are responsible for the protection of the environment to however look at our findings and come up with solutions to combat the environmental challenges with emphasis on flood impacts in the Jacob's Town Community.

Limitations

Doing onsite, surveys and flood mapping presented the following limitations:

- The flood mapping of the community can be impaired due to poor instruments because of the weather conditions.

- The hospitals are not able to have digital track record of patients that flows in during the raining season and therefore lacked more efficient data collection.

CHAPTER II

Literature Review

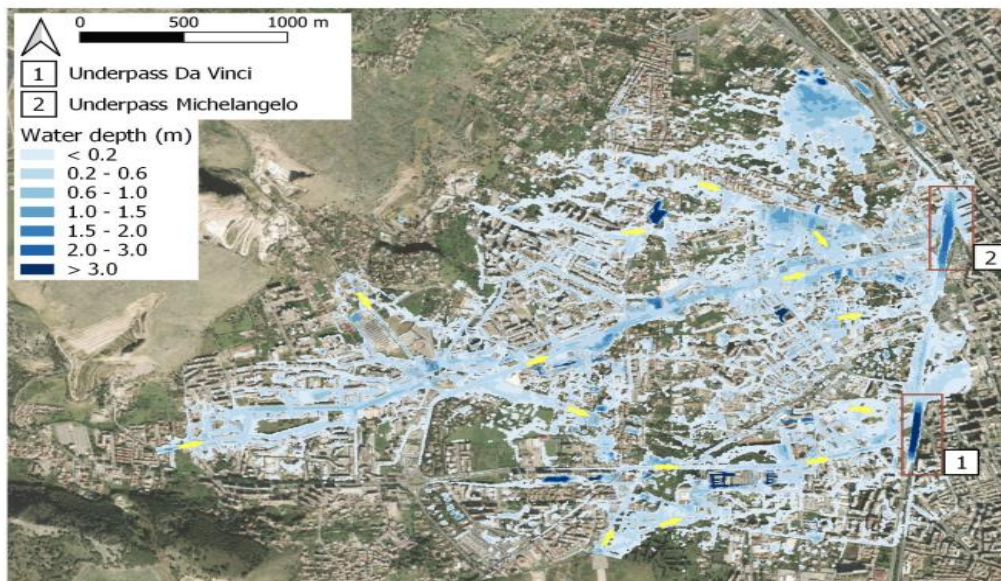
This section reviews the scientific literature on how flooding impacts the environment. It also discusses the understanding and nature, causes of flooding, reviews the positive and negative impacts of flooding, and also taking into consideration the main objectives of the work, the mitigation strategies to prevent to ensure sustainable livelihood.

Causes of Pluvial Flooding

Flooding occurs most often after heavy rains when natural waterways are not capable of carrying excess water. However, flooding is not always caused by heavy rain. They can be the result of other phenomena, especially in coastal areas where storm surge combined with tropical cyclones, tsunamis, or tidal surges can occur. A dam failure, such as an earthquake, will flood downstream areas, even in dry weather (Pianietti A, 2004).

Figure 3:

Data Satellite Imagery of Pluvial Flooding, (Venice, 2020).



Health Hazards associated with Flood Impacts

Disease and Physical Health Impacts

The health effects of surges can be broadly categorized as cooperative or destructive. Coordinate results are taken from a coordinate map in a crowded environment of water and include choking, edema and edema scars. Indirect results are associated with risks associated with uniquely constructed environmental floods, such as: B. Infectious diseases, poor health, poverty-related infections, and illnesses associated with uprooted people. gain. The health effects of the floods can be short-term, medium-term, and long-term. Floods are stuffy and most of those are due to continuous or perhaps slower river floods. Choking is common, as is the bitterness of those who underestimate power or depth control of the during late launch of the rescue attempts, or improper driving styles. Many cases of overcapacity can be caused by driving a car, flooding roads and sidewalks, or injuring in a wet accident, over 57% of the 4,444 sudden deaths across the state are associated with 4,444 vehicles (Florida MMWRm 2005).

Flood-related injuries can occur when people try to escape danger or after a building or other structure collapses. Orthopedic pain and burrs can be caused by the rapid

movement of water, including debris (Parket T, 2000). You may be injured if you return to a crowded house or office and start cleaning.

Psychological Health Impacts

After being influenced by surges, individuals may have considerable psycho-social needs, and/or create mental well-being issues and mental clutters within the brief-, medium- or long- terms. Individuals who are influenced require reacting associations to: bolster their psycho- social strength and keep up their enthusiastic prosperity; perceive and react to their trouble; and take activities to anticipate the onset of extra mental well-being issues or clutters.

These reactions must be adaptable and shifted concurring to human being's desires and concurring to them reasserts of social bolster, in addition to their economic and social circumstances. Understanding flooding in those phrases must assist and coordinate the reactions from administrations in addition to from groups.

This applies now no longer handiest to preliminary emergency responses, however additionally to guide and reconstruction at some point of healing as many human beings and groups can enjoy persevering with social and financial disruption after flooding. A multi-area technique that entails groups and households in addition to organizations is the nice manner to obtain those consequences. It is vital to apprehend that own circle of relatives and network property are vitally vital to retaining and selling nonpublic and collective psycho-social resilience.

Everyone is capable of requesting an intention to return to psycho-social. Most of people's psycho-social desires are fulfilled through their close relationships with their households, partners, and groups. Regardless, some people need to be evaluated through lifesaving authorities in case their side effects persist or are related to rupture of membranes. A smaller number are likely to need a referral for specific mental health care.

Figure 5:

Disease caused after the flood impacts (Montserrado, 2009).



Flood Prevention

Flood protection includes all measures that can help mitigate or prevent the harmful effects of floods. Some of the common techniques used for flood protection are bedrock beams, bedrock placement, sandbag installation, normal vegetation embankments, or the application of soil cement to steep embankments and the construction of drainage facilities. Other methods are embankments, dams, regulating ponds or regulating ponds. To manage the risk of floods, it is essential to take precautions and preparatory measures to avoid catastrophic events. Prevention and prevention are two precautions that precede situations that can cause harm. These principles should guide any flood defines policy. The difference between potential risk and proven risk underpins the parallel difference between prevention and prevention. Prevention is about potential risks, and prevention is about proven risks. Potential risks correspond to dangerous events that may or may not occur, and probabilities cannot be assigned, but proven risks for events that may occur.

Related Research

Flooding in West African Countries

The aim of this study was to assess floods and droughts, estimate the cost of damage at the national level, and to interpret current population reduction measures in West African countries.

The first expedition took place in the basin of the Mékrou River, a small basin in West Africa. It combines a quantitative approach to identifying areas of hydro meteorological risk (by analysing gridded climate datasets) with qualitative and quantitative analysis (WHO, 2002).

This approach makes it possible to compare the physical analysis of extreme events with human perception of flood and drought events in the Meckel Basin. Household surveys provide enough information to estimate the impact of disasters on economic costs and describe the most common mitigation measures. Mekrou is a small basin of the Niger River, with an area of 10,635 km², accounting for about 3% of the total area of the Niger Basin in Benin (Paterson et al, 2008). The average annual rainfall varies up to about 1300 mm in the southern region and up to 500 mm in the northern region. The rainy season occurs from June to September, with an average cumulative rainfall of 700 mm. Temperature also fluctuates greatly over space and time. The hottest and coldest months are April and September, respectively. The average annual temperature fluctuates between 26 and 30 degrees Celsius, the maximum is 35 to 40 degrees Celsius and the minimum is 15 degrees Celsius.

Mali: Floods

Flooding in some parts of the country affected more than 18,800 people, killing three and destroying more than 3,200 homes. Farmers also lost about 1,800 cattle. National authorities supported by humanitarian partners are assisting the most vulnerable of those affected. However, additional resources are needed to provide water, sanitation and hygiene, shelter, household items, and food. In 2017, about 11,360 people were affected by floods between June and September (OCHA August 27, 2018).

Since August 7, 2018, Mali has been affected by heavy rains, peaking between August 17 and 19, causing flooding across the country. These floods have caused significant damage to localities in six out of ten regions of the country. In addition, according to the Africa Risk Forecast from the Climate Prediction Center, according to data collected by the Directorate General of Civil Protection (DGPC), floods affected more than 137,000 people and resulted in 13 deaths.

These are becoming increasingly common throughout the region due to fluctuations in rainfall and changes in land use. In the metropolitan areas of Ghana such as Accra and Kumasi, flooding was mainly caused by seasonal rains and poor drainage.

Figure 6:

Flooding aftermath in Bamako, Mali (Cinosis, 2011).



Flooding in other Countries Worldwide

Flooding in the Indonesia

Floods have hit Jakarta some instances previously, remembering for 1621, 1654, 1918, 1942, 1976, 1996, 2002, 2007 and 2013. A large contributing variable is that a tremendous piece of Jakarta is low-mendacity; almost 24,000 ha (240 km²) of the essential piece of Jakarta are under ocean level. Flooding can emerge as intense if weighty downpour corresponds with expanded tides. At the factor while this occurs, the expanded tides pressure water into low-mendacity zones matching with the spillover from downpours in upland regions (Ahern, MS 2005).

Uncontrolled population improvement in metropolitan territories, helpless land-use arranging, and the absence of comprehension amongst metropolis population and authorities approximately floods and its fiasco threat get worse the impact.

Various conduits have been appointed disaster fame due to the excessive water stages after the precipitation.

From 18:30 WIB (11:00 UTC, WIB is UTC+07:00) on 1 January till 12:00 WIB (05:00 UTC) on 2 January, the general public authority by the way deferred all parkway

fees in Jakarta. At several portions of the metropolis, water stages arrived at 30 to two hundred cm (Kompas C, 2020). A few spots, for example, Cipinang Melayu, East Jakarta, water stages crowned at 4 meters. In extra of 397,000 populations were emptied to better grounds. The public authority had assigned faculties and authorities systems as impermanent shelters. In some territories, clearing endeavors have been hampered via way of means of surging waters and energy outages (Diaz JH, 2004).

Figure 7:

Flooding took place in Indonesia, Jakarta (El ta Vite 2011)



Mitigation Strategies

Indonesia is one of the world's biggest producers of ozone depleting substances (GHG). For as long as twenty years, GHG discharges have expanded from practically all areas, for example, land-use (characterized as land use, land-use change, and ranger service including peat fires), energy, agribusiness, industry, and waste. As of now, the land-use and energy area add to 80 percent of ozone harming substance emanations in Indonesia (Joyce S, 2000). The public administration of Indonesia has focused on diminishing unequivocally GHG discharges by 29 percent against a 2030 the same old

thing (BAU) situation and by up to 41 percent beneath the 2030 BAU level, subject to worldwide help for account, innovation move, and limit building (Shawr, 2018).

Flooding in Bangladesh

Bangladesh is a nation situated in the southern piece of the landmass of Asia. It's neighbored by India (in the West, North and East) and Myanmar (a little line in the in South East). It has a scope that ranges somewhere in the range of 20.59 and 26.63 N and a longitude that ranges somewhere in the range of 88.03 and 92.67 E. The nation is the 96th biggest country on the planet with an all-out zone of just about 144 000 square kilometers (Johnkman SN, 2008).

Since a particularly huge bit of Bangladesh's economy depends on agribusiness, flooding presents a transient issue, as a particularly cataclysmic event harms harvests and plants. Nonetheless, in the long haul, flooding can douse certain areas in supplements from water, bringing about the more noteworthy ripeness of terrains (which is one reason why a few districts in South Asia have generally ripe grounds).

Flood-hazard districts are as of now straightly focused (somewhat) along the significant waterways of Bangladesh, of which additionally associate with different nations (Khan DM 2018). The nearer a locale is to a significant stream, the more serious danger of a flood that area has (the further one moves from significant waterways, to a lesser degree a danger of a flood that district has). What's more, waterfront zones are likewise at high dangers of flooding (Kunii, N 2002).

Because of stream bank disintegration from expanding water levels, the out zone of land is being diminished from the all-around little country with a developing populace consistently because of the expanding water level after some time (Parvin G, 2022). As expansions in water levels are projected to proceed for quite a few years, the issue tormenting Bangladesh is one of the long haul.

In Bangladesh, floods assume a significant part in keeping up key biological system capacities and biodiversity.

Figure 8:

Flooding Impacts in Bangladesh (Linuous, 2005).

**Negative Impacts of Flooding**

Floods effect on each people and groups, and feature social, financial, and environmental effects. The effects of floods, each terrible and positive, range substantially relying at the place and volume of flooding, and the vulnerability and cost of the herbal and built environments they affect (French J, 1969).

The effects of floods, each terrible and positive, range substantially relying on their place, duration, intensity and speed, in addition to the vulnerability and cost of the affected herbal and built environments. Floods effect each people and groups, and feature social, financial, and environmental effects

Floods have huge social effects for groups and people as maximum humans are nicely aware, the on the spot influences of flooding encompass lack of human existence, harm to property, destruction of crops, lack of livestock, and deterioration of fitness situations (CDC, 2015). As communicate hyperlinks and infrastructure including electricity plants, roads and bridges are broken and disrupted, a few financial sports may

also come to a standstill, humans are compelled to depart their houses and everyday existence is disrupted.

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Because of stream bank disintegration from expanding water levels, the all-out zone of land is being diminished from the all-around little country with a developing populace consistently because of the expanding water level after some time. As expansions in water levels are projected to proceed for quite a few years, the issue tormenting Bangladesh is one of the long haul.

CHAPTER III METHODOLOGY

This Chapter discusses the methodological picks made via way of means of the researcher. Specifically, dialogue of studies strategy, studies methods, information series method, method of the study, the general public establishments and the case companies.

Study Area

Monrovia is domestic to a developing populace of 1.3 million tenants. Flanked on either side by the Atlantic Sea and mangrove-filled Mesurado and Holy person Paul waterways, the capital city has few choices for extension. Two out of three Monroviens dwell within the spontaneous and ghetto communities in swamps and swamps along the Stockton Stream and Du Waterway banks, counting Slipway, Doe Community, Saye Town, Logan Town, Clara and By means of Towns, and the renowned worldwide West Point. Population development, combined with inner relocation from a 14 year long respectful war, has driven to the fast extension of casual settlements in high-risk zones of Monrovia. Nowadays their arrangement in low-elevation coastal regions and swampy flood-prone arrive has ended up a unsafe calculate for residents well-being and business.

Nearly 90 percent of the populace is living at chance of flooding from the ocean, waterway framework, swampland and clogged channels. Amid the surge period, kids are incapable to take off homes to go to school nor is there a space to sit nor play, whereas the men need to walk through unhygienic surges in look of nourishment. Families, especially children and ladies, are hit by cases of jungle fever, loose bowels, and cholera – all compounded by these waters. Squander and sanitation services are restricted, advancing these dangers. Few shared toilets exist within the communities, taking off more than 80 percent of inhabitants to hone open defecation in areas uncovered to surge. There are no sources of clean drinking water and greatly limited versatility confines squander collection and crisis get to. Amid one of our community engagements, Madam Mariah K. Abu, Chairlady of Doe Community Ladies Affiliation, depicted her family's four days relocation from their domestic due to tall water levels.

Monrovia is home to a developing populace of 1.3 million occupants. Flanked on one or the other side by the Atlantic Ocean and mangrove-filled Mesurado and Saint Paul waterways, the capital city has not many choices for development. Two out of three Monroviaans live in the spontaneous and ghetto networks in marshes and bogs along the Stockton Creek and Du River banks, including Slipway, Doe Community, Saye Town, Logan Town, Clara and Via Towns, and the celebrated West Point. Populace development, joined with inside movement from a long term long respectful war, has prompted the fast extension of casual settlements in high-hazard zones of Monrovia. Today their position in low-rise waterfront territories and muggy flood-inclined land has become a hazardous factor for inhabitants' well-being and work. In some ghetto networks, weighty precipitation and low heights mean all year flooding.

Data Approach

The principle objective of this examination work is to recognize the well-being impacts that flooding has on the Jacobs Town Community. There are numerous Liberians that are enduring a great deal because of the effects of the flood as far as cold and other water borne illnesses. For the quantitative methodology an organized poll was ready and shipped off the Respondents by email through auto google structure application and posting and the responses are brought into the SPSS programming for exact examination of after-effects of the review. A survey is an advantageous method for leading this exploration on the grounds that the examples of individuals who answer the inquiries are situated in Liberia.

The benefit in involving an organized poll in the idea of this proposition research is the least expensive method for doing research and it is likewise moderately quick to get reactions and furthermore gives space for huge example to be spread over a wide region to be overview. For example, sending the polls by means of posting and messages, additionally keep away from the like inclination that might emerge because of up close and personal meeting. Individual questions are more addressed as the respondent isn't in an eye to eye circumstance with the questioner. Notwithstanding these benefits in

utilizing survey there are a few detriments too. The inquiries should not be confounded for each respondent to comprehend. The analyst will most likely be unable to get unconstrained responses from the respondent, and furthermore the respondents' chance to examine any inquiries with others prior to noting the survey. And furthermore sometimes it can't be find out whether the named answer is really the one that finished the survey. The previously mentioned inconveniences somehow have adverse consequence on the dependability and legitimacy of the exploration (McDaniel, Roger, 2009).

Agencies/Companies Profile

Environmental Protection Agency (EPA)

The Environmental Protection Agency (EPA) is an administrative Institution of the Government of Liberia for the sustainable management of the environment and its natural resources. The Agency was established by an act of the Legislature November 26, 2002 and published into hand bill on April 30, 2003. (EPA Act,2002)

Monrovia City Corporation (MCC)

The City of Monrovia was established in 1816 determined to lay out an independent state for liberated American slaves under the protection of the American Colonization Society (MCC, 2016).

Public Works Ministry (Zooning Department)

Ministry of Public Works in 1972 to enough oversee the Engineering part of the State with regards to studying, drafting/planning, development and oversight, to improve and keep up with, direct or by contract all expressways, spans, streets, streets, air terminal, seaport, and any remaining public infrastructure in the Republic of Liberia (MPW, 1972 Act).

Early Warning System Liberia Project (GIF)

Ministry of Public Works in 1972 to sufficiently oversee the Engineering part of the State with regards to reviewing, drafting/planning, development and management, to improve and keep up with, direct or by contract all roadways, spans, streets, streets, air terminal, seaport, and any remaining public infrastructure in the Republic of Liberia.

Liberia Water Company

The Liberia water and Sewer Corporation was made by an Act to correct the Public Utilities Law in 1973. The Corporation is engaged to build, introduce, lay out, work, oversee and supply to all pieces of Liberia, safe drinking water and play out all sewerage administrations, as well as to keep up with such water and sewerage offices.

Data Collection & Analysis

The researcher uses qualitative research technique as a strategy to provide results from data that were collected, through the use of SPSS Software data analysis.

Population Analogy

In the Jacob's town community, there is a lower rate of student going people, very high unemployment rate and lots of little businesses all across the community. Because of the increase in poverty within this community, most inhabitants don't have sufficient finance to purchase better land space therefore they consider purchasing cheaper lands to build their houses within the wetlands which blocked water ways. Because of the lack of proper waste management knowledge, they also empty their waste within the waterways, promoting flooding when heavy rain falls.

Table 1:
Total Population Categories

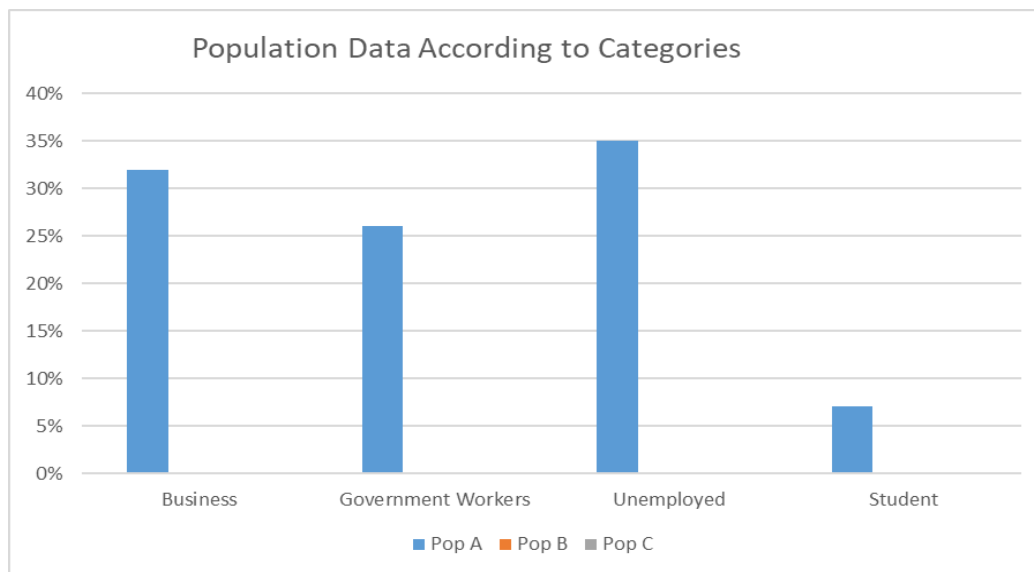
No.	Population	Total Percentage in Categories
1.	Business	32%
2.	Government Workers	26%
3.	Unemployed	35%
4.	Student	7%
Total		100%

To get the population data of the research study area, the community was divided into 4 (four) categories: Business, government workers, unemployed and students. The population data/statistics show that 32% of the total population are Business people, 26% government workers, 35% unemployed and 7% students. This is the total number of people into categories, residing in this area.

Table 1 below illustrates the Population according to different categories as it relates to flooding experience. The below graph indicates that the number of unemployed people experiencing flooding are high in number which is 35%, while the number of business people include 30%, follow by the number of government workers which is 25% and lastly the number of students cover 10%.

Figure 8:

Population Data 1



The mode of data collection was done through questionnaires of which 197 questionnaires were sent and each paper contains 20 questions to gather data from government institutions, individuals residing to the research study community and other private companies. The mode of data collection was through google form questionnaires that was sent to said emails and phone calls. This data collection includes participants which were selected from relevant authorities related to environmental issues such as: Environmental Protection Agency (EPA), Monrovia City Corporation (MCC), Ministry of Public Works (MPW), The Early Warning System and the Liberia Water Company.

Sample Size

The sample size represents the targeted respondents in this study, was obtained by using the following equation 3.1 which was developed by Gogtay in 2010 with 95% confidence level, while the correction for finite population was achieved applying formula 3.2 (Gogtay, 2010).

$$S = \frac{Z^2 * p(1 - p)}{c^2} \quad (3.1)$$

Where

S: sample size from a finite population.

$Z = 1.96$ for 95% confidence level

$p =$ percentage picking a choice, expressed as decimal (0.5 used for sample size needed)

$c = \pm 0.05$ confidence interval

$$S = \frac{1.96^2 * 0.5(1 - 0.5)}{0.05^2} = 384.16 = 385$$

Correction for Finite Population

$$S = \frac{S}{1 + \frac{S - 1}{N}} \quad (3.2)$$

$$S = \frac{385}{1 + \frac{385 - 1}{250}} = 151.8 = 152$$

The population targeted in this study is 250 in total, therefore 152 of respondents can be considered as the minimum sample size for this study. After distributing of questionnaires a 211 of respondents were collected which indicate that there was 38.82% increase on numbers above the required limit. Moreover this leads to get more accurate data which results in strong outcomes of the research.

Gogtay, N. J. (2010). Principles of sample size calculation. *Indian Journal Ophthalmology*, 58(6), 517-518

Data Collection

250 surveys was established, the objective populace by means of google structures through messages and presented on three contact people who assisted the scientist with disseminating the polls to the respondents the contact people have insight of exploration work the main individual is senior bookkeeper with the state the subsequent individual is executive director of the environmental protection agency what's more 250 update messages were sent following fourteen days of the principal email 154 responses were gotten from the 250 surveys which put the reaction rate at 7817 the poll was embraced from past investigations that were led by European school in Gladenbach whose point is to overview the disposition of individuals from various nations towards sustainable power sources it is all around planned and organized such that it is simple for the respondents while perusing the filled in polls structures it appears to be the inquiries were surely

known by the respondents to empower an extensive factual investigation of the responses the inquiries and answers were brought into the statistical program for social sciences SPSS.

Table 2:

Questionnaire Data Analogy 1

Questionnaire	Numbers With Percentage (%)
Sent	250 %
Received	154 %
Percentage	78.17%

Study Success

The SPSS is a program that permits imported information to be broke down and analysed through various tables and diagrams legitimacy and reliability of the study the subjective exploration strategy focuses regularly on a solitary case interestingly the quantitative examination technique utilizes many examples nonetheless in the subjective exploration technique the low number of tests for the most part turns into a negative part of this is on the grounds that it is more challenging to sum up however it should generally be as a main priority whether the point of the review is phenomenological demeanour or positivism direction that decides the kind of the exploration the distinctions of assessing the nature of studies in the subjective exploration and quantitative examination are one reason that the dependability idea is immaterial in subjective examination technique the idea of dependability is supposed to be deceiving and have a results assuming it is set as a basis for subjective examination technique on the off chance that the review is talked about with unwavering quality (Setback, 2001, p.552) legitimacy depicts regardless of whether the point of the exploration has been accomplished legitimacy in a review is viewed as reached on the off chance that the main interest group and question are the right ones to expand the legitimacy of a review the interest group should be viewed as well and that the crowd completely addresses the populace the objective gathering is picked arbitrarily in quantitative exploration strategy as against the case in subjective

examination technique over the review the estimation techniques ought to stay predictable while dissecting the consequences of subjective examination strategy constancy believability and adaptability the trustworthiness implies that the outcome can measure up to earlier investigations on similar peculiarities the validity implies that the examination is sufficient and gives the right image of a peculiarity while the adaptability is depicting on the off chance that the outcomes can be utilized or moved to another or further exploration the legitimacy and unwavering quality of this study is upheld by the realities that every one of the sources that were utilized in this theory are pertinent to the subject and furthermore solid what's more various sources with alternate points of view that are connected with the subject were utilized 48 while composing this postulation a large portion of the data that were accumulated for the hypothetical part are from books nonetheless more logical diaries with respect to the subject were utilized and web sources the unwavering quality of the review is reached on the grounds that the objective gathering of the review addresses the populace well likewise the inquiries posed from the objective respondents were right and furthermore associates with the point of the review the dependability of the review is upheld by the way that the review is reliable since the outcomes can measure up to prior concentrate on outcomes likewise while making both the survey and the inquiries questions an endeavour was made that the inquiries were written in a reasonable manner that they were all around as unbiased as conceivable not abstract the aftereffects of the triangulation approach that were utilized are viewed as more solid and objective in nature progress of the study through and through the exploration can be supposed to find success in light of the fact that the analyst accepts that the objective populace saw well every one of the inquiries in inquiries questions the specialist was amazed with the work of the respondents to record a few ideas for enhancements and more elaboration for questions assuming they had a few different responses or suppositions to share what's more additionally inquiries questions length were great since they are not excessively lengthy for the respondents to lose interest or get exhausted with it while replying the inquiries were written in an unmistakable language and they are straightforward which work on emphatically the unwavering quality of the review notwithstanding this both the inquiries questions and poll relate well

to the point of the review ultimately the reaction can be very much contrasted and before research discoveries of the subject.

Research Findings

The google structure questions were established to 250 people, 154 respondents finished up the poll and sent it back which gives a reaction pace of 7817 the strategy utilized was a comfort testing technique since the point of the review is to distinguish the well-being impacts that flooding has on the Jacobs town community the comfort testing technique implies that the respondents have been chosen based on their accessibility utilizing comfort examining strategy to direct a review might prompt an extremely high reaction rate which occurred in this review greater part of the 154 respondents were between the matured of 19-25 the initial two inquiries in the poll were pointed toward gathering some foundation data the principal question was about the age of the respondents and the subsequent inquiries posed on the off chance that the respondents have a profound knowledge of populace inside the review region a bar graph of every one of the inquiries is made with the rates introduced and made sense of furthermore a few remarks are added that have happened from the outcomes the entire survey is broke down.

CHAPTER IV FINDINGS AND DISCUSSION

Comments about the Questionnaires

The survey has been first rate and very much investigated. The pre-owned survey was the most effective way to investigate the populace's opinion regarding the matter of the review. The poll inspects the respondents' perspectives and information about the various types of well-being risks related with flooding. Subsequently from the rate computation, more individuals know about the medical conditions that is related with flooding.

Questions of the Interview

27 open inquiries were made by and large, which were construction to cover what isn't all around shrouded in the poll. The initial five inquiries give the outline about the business of the local area with regards to flood and its effects. The following meeting of inquiries give an outline and profound knowledge of flood effects and what it has meant for the soundness of people and the climate.

Table 3:

The number of respondents for the interview questions

	Waterborne diseases percentage from flood	What was the effect by flooding	Damage to materials	Were health facilities hit by flood impacts	Sources of survival for likelihood	Were educational places affected
Valid	152	152	152	152	152	152
Missing	0	0	0	0	0	0
Minimum	-	-	-	-	-	-
Maximum	-	-	-	-	-	-

Table 3 shows the interview questions and the number of respondents. Out of all the questions sent out 152 were answered and it shows that the increase in waterborne diseases from flood is at a high increase and impacted lots of areas such as: health and school facilities and even homes.

Table 4:

Minimum and Maximum of Age to that of effects from flooding impacts

Descriptive Statistics of Water Resources Impacts						
	No	Min.	Max.	Mean	Std Deviation	
Age	152	15	65	29.22	9.879	
Percentage of Water resources affected by flood	126	30	95	54.60	15,305	
Valid number	126	-	-	-	-	

Table 4 shows the minimum and maximum of age to that of the effects of flood impacts, the correlation to that of the percentage of waterborne diseases.

Table 5:

The population data analysis on affected People by flood impacts taking into consideration of aging

Population Data Statistics				
	Number	Mean	Std. Deviation	Variance
Age	152	29.217	9.846	96.946
Percentage of water resources affected by flood	126	54.603	15.244	232.382
Valid number	126			

Table 5 is a complete population analogy is makes the researcher to have a clearer picture on the population that are affected by the impacts of flooding.

Table 6:

The percentage of waterborne diseases from data collection

Valid	Frequency	Percent (%)	Cumulative Percent (%)
2-5%	1	0.7	0.7
5-10%	29	57.2	19.7
Over 10%	87	23.0	77.0
Total	152	100.0	100

Table 6 shows the percentage of waterborne diseases from the data collection. It illustrates the frequency and percentage of the diseases from waterborne diseases.

Table 7:

The Age Ranges of Each participant for the interview

Valid Numbers	Frequency	Percent (%)	Cumulative Percent (%)
19	7	4.6	6.6
20	5	3.3	9.9
21	14	9.2	19.1
22	13	8.6	27.6
23	14	9.2	36.8
24	8	5.3	42.1
25	11	7.2	49.3
26	3	2.0	51.3
27	6	3.9	55.3

28	8	5.3	60.5
29	8	5.3	65.8
30	3	2.0	67.8
32	2	1.3	69.1
33	5	3.3	72.4
34	5	3.3	75.7
35	5	3.3	78.9
36	3	2.0	80.9
37	4	2.6	83.6
38	4	2.6	86.2
39	2	1.3	87.5
40	5	3.3	90.8
43	1	0.7	91.4
45	2	1.3	92.8
47	1	0.7	93.4
50	2	1.3	94.7
53	1	0.7	95.4
55	1	1.3	96.7
57	2	0.7	97.4
59	1	0.7	98.0
60	2	1.3	99.3
65	1	0.7	100.0
Total	152	100.0	100.0

Table 7 shows the public road being affected by flood mostly forming run-offs and putting yes at the accumulated percent.

Figure 9:
Age of Participants

Age

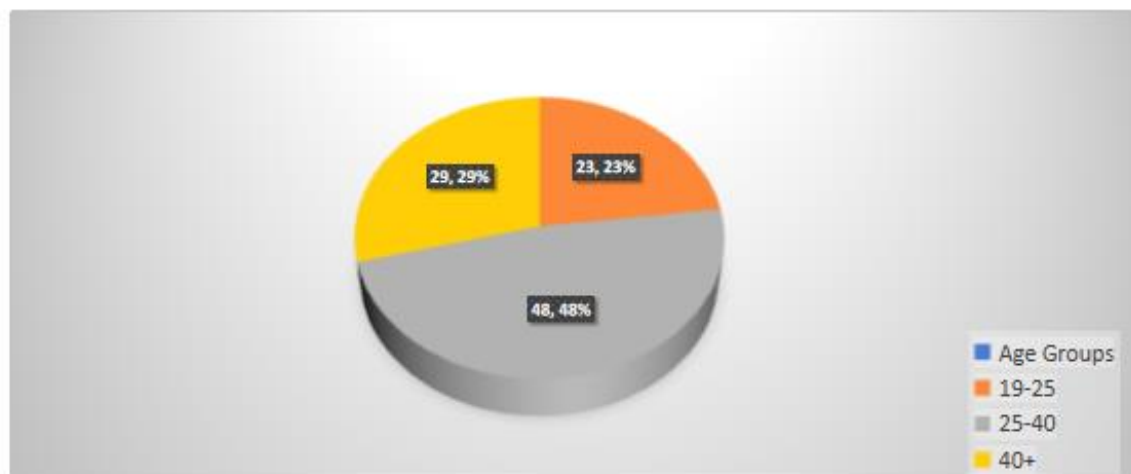


Figure 9 above delineates the age of the respondents which assist us with understanding how the respondents' perspectives and information fluctuates with age. The biggest number of the respondents fall between the matured of 19-25 adding up to 27 which addresses 32.14% out of the addressed polls. Followed by 25-40 age gatherings, establishes just 4.76% of the absolute respondents. The respondents' age shows that more youth in the nation are focusing closer on issues.

Furthermore, more work actually should be done about illuminating the overall population on what is flood sway and assuming you consider the quantity of the respondents that can't list 3 effects of flood which remains at 30.95%, adding up to in number 26. Greater part of the respondents might have essential education since the vast majority of them live in metropolitan regions.

Table 8:
Diseases from Flood impacts

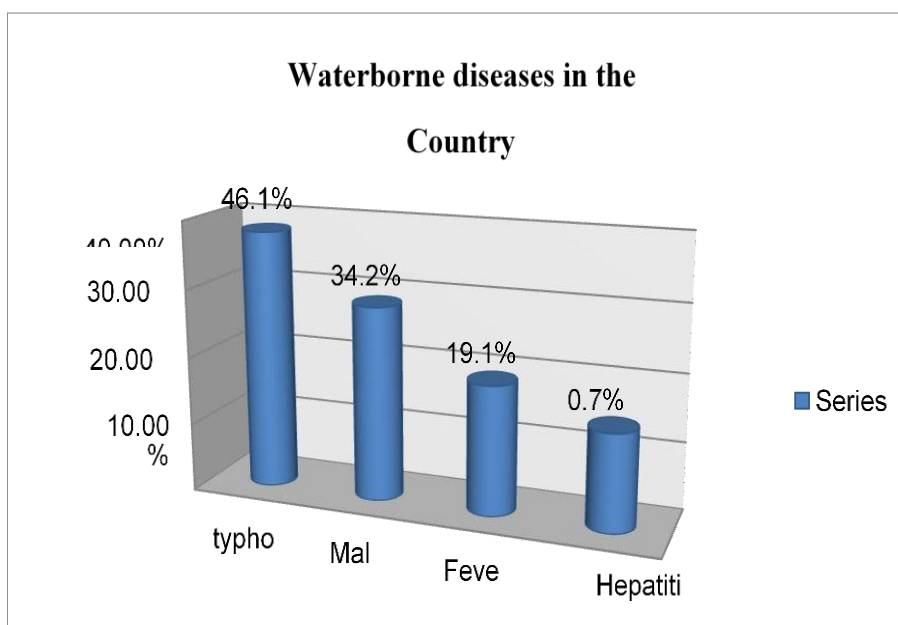
Valid	Frequency	Valid Percent (%)	Cumulative Percent (%)
-------	-----------	-------------------	------------------------

Fever	29	19.1	19.1
Hepatitis	1	0.7	19.7
Malaria	52	34.2	53.9
Typhoid	70	46.1	100.0
Total	152	100.0	100.0

Table 8 this table shows all the age ranges of the respondents from the question set out this helps the researcher to understand the ability of where the researcher is getting his data from.

Figure 9:

The Statistics of waterborne diseases



This question helps us in understanding on the off chance that the respondents had the option to know the most well-known waterborne illnesses in Liberia and furthermore to recognize the sources. Greater part of the respondents for example 46.1% select Typhoid as the most widely recognized one among the four, 34.2% addressed Malaria, 19.1% pick Fever, and 0.7% pick hepatitis as their response. Typhoid is the most well-known source high pace of sickness in Liberia which is most ideal choices from every one of the respondents.

Table 10:

The frequency of what were affected by the flood

Frequency of affected areas by the flood			
Valid	Frequency	Valid Percent (%)	Cumulative Percent (%)
Low Effect	7	4.6	4.6
Moderate Effect	67	44.1	48.7
Severe Effect	78	51.3	100.0
Total	152	100.0	100.0

Table 10 this shows the general sickness and disease associated from the impacts of flooding that is very dangerous to human's health.

Table 11:

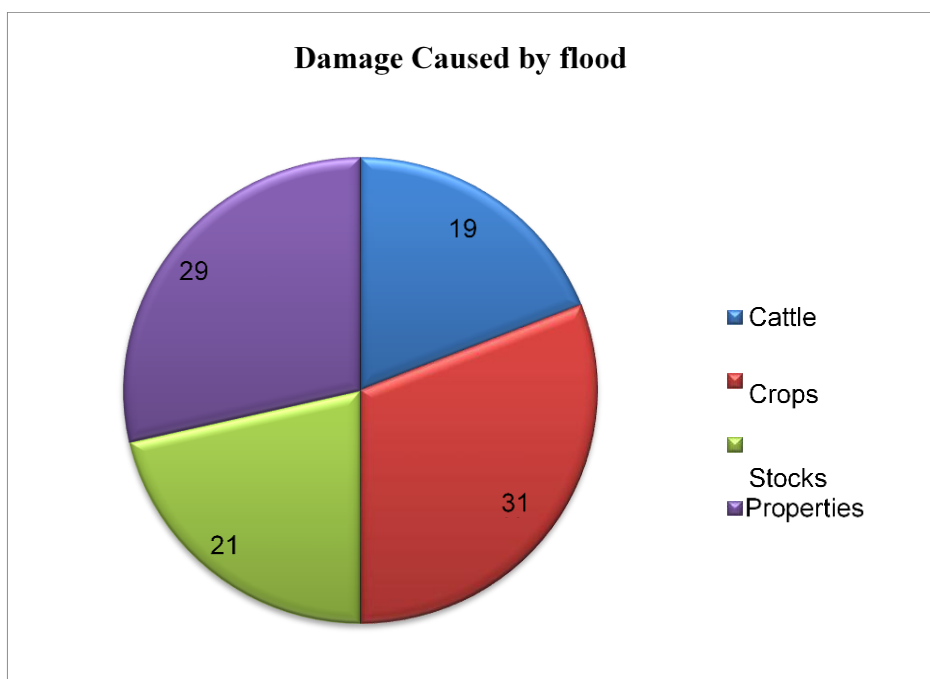
The frequency of materials damaged by the flooding

Frequency of Materials damaged by the flooding			
Valid	Frequency	Valid Percent (%)	Cumulative Percent (%)
No	6	3.9	3.9
Yes	146	96.1	100.0
Total	152	100.1	100.0

Table 11 shows the severity of the frequency of what were affected by flooding It states that there is a severe Impacts of flood making higher accumulated percentage.

Figure 7.

Damage caused by the flood Impacts



This question concerns the need acknowledgment on how the respondent rate harms of flood to the Environment. 30.95% percent of the respondent says the yields are love from flooding. 28.57% addressed that properties are harmed, 21.43% of respondents addressed palaces are likewise impacted and 19.05% of the respondents addressed stocks are impacted as well. Liberia is one of the nations on the planet in which the public authority pay endowment in all the well-being areas of the country.

Table 12:

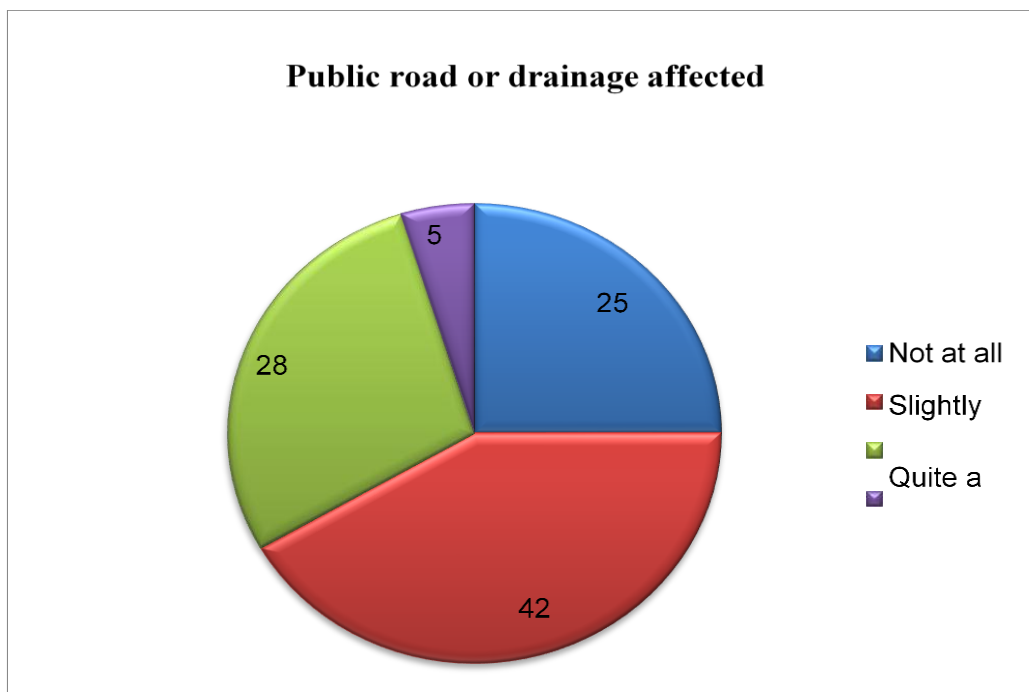
The Affected Public roads by the flood

Frequency Data of Affected Public Roads			
Valid	Frequency	Valid Percent (%)	Cumulative Percent (%)
No	3	2.0	3.9
Yes	146	96.1	100.0
Total	152	100.0	100.0

Table 12 shows the frequency of materials damaged from flood impact. This data confirmed yes at in percent cumulative percentage that flood impact is very high

Figure 8:

The Impacts on Drainage in the community



This is an open inquiry that was posed for the need acknowledgment whether the respondent has a lot of experience with the effects of flood on open streets. 41.67% of the respondents addressed that it impacts the road "tremendously", trailed by 28.57% which believes that it will affect "Quite a ton", and 25.00% addressed "Not by any means", 4.76% of the respondent are not exceptionally certain so they addressed somewhat.

Results from the interview

Subsequent to dissecting the aftereffects of the meeting, one might say that there isn't a lot of contrast in greater part in the responses gotten up until this point. The initial six addressed the effects of flood on wellbeing and the climate comes from absence of mindfulness and obliviousness.

They likewise made notice on the Line Ministries and Agencies not appropriately accomplishing the work most particularly the see-pages out and about are supposed to be hindered with loads of waste materials filling in as a barricade and causing flooding. Clinics and Clinics made notice additionally on their measurements of the expansion in waterborne infections generally during the blustery season.

CHAPTER V
CONCLUSION AND RECOMMENDATION

Conclusion

The main objective of this research work is to identify the health impacts that flooding has on the Jacobs Town Community and therefore close the gap to 50 to 60 percent of Liberians that are highly affected by the waterborne diseases due to the flood impacts. A qualitative method was used in the methodology to analyze the findings and conclusion was made.

The survey questionnaire was done through emails and the population that answered the questions were divided in to different sectors of which some were government officials, business, unemployed and students. The data shows that the highest population of 35 percent unemployed in that they do not have the financial stand to recover from the flood impacts. Of the survey data collected from over 200 emails, there were 154 respondents that reacted to those questionnaires.

There were different questions that the researcher wanted to understand to draw conclusions from the ongoing impacts of flooding in the ja-cob's town community. Some questions include the waterborne disease percentage from flood impacts, what materials or stock got affected by the impacts including health facilities and educational places.

There are numerous Liberians that are enduring a great deal because of the effects of the flood as far as cold and other water borne illnesses. For the quantitative methodology an organized poll was ready and shipped off the Respondents by email through auto google structure application and posting and the responses are brought into the SPSS programming for exact examination of aftereffects of the review. A survey is an advantageous method for leading this exploration on the grounds that the examples of individuals who answer the inquiries are situated in Liberia.

Another data approach that helped the researcher to understand the health impacts helps us understand the health impacts is the increase in different types of diseases arising from flood impacts and it helps in understanding if the respondents were able to know the most common waterborne diseases in Liberia and also to distinguish between the sources. Majority of the respondents i.e. 38.10% select cholera as the most common one among the four, 28.57% answered typhoid, 19.05% choose tuberculosis, and 14.29% choose

Lassa fever as their answer. Cholera is the most common source high rate of disease in Liberia which is most favorable options from all the respondents.

Liberia is a country, which possess 49 percent of the upper Guinea Forest and also get higher percentage of rainfall ever-year. In Liberia the increase in sickness from waterborne diseases is at an increase therefore causing malaria, cholera, diarrhea, fever etc.

Therefore, the Ministry of Environment should focus on the implementation of the environmental health and safety rules and also other line ministries and agencies like the Ministry of Public works should properly construct drainage and remove all houses from the alleys for the free passage of water to prevent flooding.

In the Jacobs Town community, there has been major outbreak of cholera and the statistics from the hospitals and clinics around shows the percentage of admitted patients during the rainy season as compare to the dry season from water borne diseases, therefore it is prudent that an awareness be taken on a loud spree to against waste pollution, and a lot more to health curtail the reduce the flood risk impacts.

CHAPTER VI

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<https://bit.ly/39KSubM>

**AN INVESTIGATION OF THE IMPACTS OF FLOOD IN THE
PAYNESVILLE, MONTSERRADO, LIBERIA**

Participant Information Sheet and Informed Consent Form

Dear Participants,

I am writing my thesis that seeks to survey your opinion on how to support, promote and find mitigation measures to the impacts of flood in Liberia to close the gap of almost 60-70% of Liberians that are highly affected by the impacts of flood in order to have an environmentally friendly atmosphere.

By agreeing to participate, an interview session will take place through phone calls and emails of which all information will be kept confidential. The data collected and information provided, will be stored for 2 years with security access lock so that others cannot get the information after which it will be deleted from the database. All interviews will be transcribed by anonymizing any identifying information.

Please note that your participation in the study is voluntary and the data collected during the course of this study will be used for the academic research purposes only of which your identity will not be revealed in any case to third parties and pseudonyms will be used in all observational and interview data.

You may quit participating at any time by contacting us. If you opt out the study, your data will be deleted from our database and will not be included in any part of the study.

In case you have concerns and questions, please contact us using the information below.

Signature:

Assoc. Prof. Dr. Fidan ASLANOVA

Environmental Science and Engineering Department

Email: fidan.aslanova@neu.edu.tr

Prof. Dr. Gözen ELKIRAN

Civil Engineering Department

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Appendix - 1**QUESTIONNAIRES**

Dear Respondent,

I am writing my thesis that seeks to survey your opinion on how to support, promote and find mitigation measures to the impacts of flood in Liberia to close the gap of almost 60-70% of Liberians that are highly affected by the impacts of flood in order to have an environmentally friendly atmosphere.

I hope you will have few minutes to contribute to this study. I am very grateful for your time and effort when answering these questionnaires.

1. Please indicate your age grouping

Under 14 14-19 19-25 25-40 over 40

2. Can you list some impacts of Flood? *Yes No*

3. What percentage of Water-borne diseases in our country do you think is influenced? by flood impacts? *Nothing 2 - 5 percent 5 - 10 percent over 10 percent*

2. What is the most common disease from flood?

Typhoid, Fever, malaria, hepatitis

5. Are Public road or drainage affected? *Yes No*

6. Are homes build in line with zoning regulations? *Yes No*

7. Does Flood occur only when it rains? *Yes No*

8. Damage to Materials, stock, goods, and crops? *Yes No*

9. How would you prepare for the Flood?

10. Is government intervention on the crisis impacts up to the task? *Yes, No*

Thanks for taking part in the survey

Appendix - 2**INTERVIEW QUESTIONS****Livelihoods**

1. What are the three main sources of livelihood for most households in the community?

2. What are three secondary sources of livelihood for most households in the community?

3. What are three main sources of income?

4. What are three main sources of food?

5. How would you describe the impact of the floods on people's livelihoods?

6. Impact of Floods

How was the flood experienced different from other years (*in terms of timing, level, etc*) Is there any data available?

7. What was the effect of the flood on the following Areas.

Level of Effect 1 = No Effect

2 = Moderate

3 = Severe

8. Indicate areas affected by flood, giving an estimate of the people affected

9. Were health facilities in the flooded area(s) affected? If yes, explain to what extent they were affected.

10. Was there any disruption in the access to health facilities? If yes, provide details of the disruption.

11. Explain on the Sanitation (Access) during the flood

12. Was there an increase in disease outbreak/ incidents due to the floods?) Explain giving details of major health problems and age groups affected).

13. What are the common water sources in the community?

14. What percentage of the community water sources were affected by the floods?

15. Did the affected households experience any water accessibility problems?

16. What are the three main types of sanitary facilities used mostly in the Community?

17. What type of infrastructure (road, bridges/ culverts) are available in the community?

18. What was the impact on the infrastructure?

19. Was there any educational infrastructure affected by the floods in the district/ community? If yes, provide details;

20. Was there any disruption in learning due to floods?

21. Did the communities experience crop and livestock loss due to floods? Explain by giving details of losses and estimate population affected.

22. What was the impact of the floods on people's houses? (Explain in detail)

23. What in your view are the underlying causes of vulnerability on the district/ community? Elaborate.

24. Who are the most vulnerable groups?

25. What is the normal pattern of flooding in the district/community?

26. What are three main coping strategies if any, that people of the district/ community employ during floods?

27. What are the development options that might address the flood patterns in both short and long term in the district/community?

Appendix - 3**LIST OF PARTICIPANTS**

Mr. Anthony Menlor	CEO, Green Builder Project
Executive Director	Environmental Protection Agency
Managing Director	Ministry of Public Works
Deputy Director	Monrovia City Corporation
Junior Staff	Monrovia City Corporation
Project Manager	Early Warning System Project
Manager	Liberia Water Company

Appendix – 4

**BİLİMSEL ARAŞTIRMALAR ETİK
KURULU**

07.07.2021

Dear Burton Dorley

Your application titled **“The Impacts of Flood in Paynesville, Montserrado, Rehab Community, Liberia”** with the application number NEU/AS/2021/124 has been evaluated by the Scientific Research Ethics Committee and granted approval. You can start your research on the condition that you will abide by the information provided in your application form.

Assoc. Prof. Dr. Direnç Kanol

Rapporteur of the Scientific Research Ethics Committee

Note: If you need to provide an official letter to an institution with the signature of the Head of NEU Scientific Research Ethics Committee, please apply to the secretariat of the ethics committee by showing this document.

Appendix – 5

Appendix – 6**CURRICULUM VITAE**

Name: **Burton Dorley**
 Address: Hamitkoy, Asok Apartment, Cyprus
 Contact No. +905488323193
 Email: bdorley1@gmail.com

PERSONAL INFORMATION

Place of Birth: Bong County

Citizenship: Liberian

EDUCATIONAL BACKGROUND

2020 to present MSc Environmental Sciences and Engineer

2019 Kofi Annan Institute

2017 – 2019 Bachelors of Science Degree, Environmental Science

2015 - 2017 Associate of Science Degree from the Stella Maris Polytechnic in Environmental Science

2015- Monitoring and Evaluation Training

2012-2014 St. Clement University College, majoring Mining Engineering

2002-2012 Soltiamon Christian High School, obtained High School Diploma and WAEC Certificate

WORK HISTORY

(2019 - 2020) Environmental Focal Person for the MBH Power Limited (Duties: Ensure the safety of workers health and the Environment, formulating method statement for civilworks, shrinking, tower erection and also doing a risk management plan) Deputy Executive Director, Youth in Action for Peace Development Initiative Liberia (2018 –2019) Duties: Assist the Executive Director to supervise and ensure all projects are well implemented Project Manager for Conscious Environmental Youth

Alliance (2016 – 2018). 2014 I served as Tunza Eco-Generation Regional Ambassador

Duties: I conducted awareness to selected schools informing them about the problems relating to the environment and how to tackle those problems to make the environment a health and safer place to dwell.

2014 Served as an observer during the Senatorial Election for the Electorate Coordinating Committee Duties.