Training manual for climate disaster risk management

Deutsche Gesellschaft
für Internationale
Zusammenarbeit (GIZ) GmbH

TRAINING MANUAL FOR CLIMATE DISASTER RISK MANAGEMENT

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On behalf of:

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

of the Federal Republic of Germany

NADMO GHANA

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MODULE 1

PREFACE

PREFACE

Anthropogenic greenhouse gas emissions have increased over the last century – driven largely by economic and population growth, and have induced unprecedented changes in the global climate system. These changes include increased surface temperatures, rainfall variability and increase in frequency of extreme events such as drought, floods, heat waves, storms and sea level rise among others.[1,2,3,4,5] The Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report highlighted that the frequency and intensity of droughts and floods have increased in West Africa since 1950, and by projection, the burden is expected to be exacerbated with population which is likely to double by 2050.[6]

Climate change has direct socio-economic impacts on sectors and systems such as agriculture, forestry, fisheries, water resources, human health, human settlements and ecological systems, and hence affects livelihoods in developing countries. Ghana has not been an exception and the dire consequences of climate change in the form of extreme events affect agriculture and other socio-economic activities. Climate change, therefore, increases the need for the country to position itself with cost effective climate risk management standards, and more robust and efficient climate change adaptation strategies. This will help reduce the country's vulnerability.

1 IPCC TAR, 2001a. Climate Change 2001: Impacts, Adaptation and Vulnerability. IPCC Third Assessment Report, Cambridge University Press.
2 IPCC TAR, 2001b. Climate Change 2001: The Scientific Basis. IPCC. IPCC Third Assessment Report, Cambridge University Press
3 IPCC, „Summary for policymakers", Climate Change 2007: Working Group III: Mitigation of Climate Change, Table SPM.3, C. Mitigation in the short and medium term (until 2030), in IPCC AR4 WG3 2007.
4 IPCC, „Summary for Policymakers", Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007, Human and Natural Drivers of Climate Change, in IPCC AR4 WG1 2007.
5 „IPCC, Climate Change 2013: The Physical Science Basis – Summary for Policymakers (AR5 WG1)". p.17.
6 Knippertz et al., 2015: "Key research and prediction challenges for West and Central Africa". Special Issue on Monsoons: Advancing understanding of monsoon variability and improving prediction.

Flooding has become quite a norm in Ghana with periodic occurrences on inter-annual and intra-seasonal bases. This could primarily be related to the increasing variability in the rainfall patterns countrywide, poor drainage systems, and building on waterways, amongst other reasons. Instances of flash flooding have claimed several lives and caused damages to properties running into millions of Euros in recent times. In urban areas such as Accra and Kumasi, the results of these floods are further exacerbated by the poor developmental planning of residential areas, improper placement of structures and the lack of or inadequate information on early warning systems.[7]

The major disasters in Ghana include floods, fire outbreaks, pest infestations and droughts. Most often authorities and responsible agencies struggle to deliver effective emergency relief to contain the situation. Owing to the inadequate preparation to manage such disasters, this usually leave a financial burden on the government and the people/communities at large. In order to prepare adequately for these climate extremes and their associated disasters, there is the need as a country to have an efficient climate risk management system. Such a system should include the provision of appropriate short training programmes for National Disaster Management Organization (NADMO) and its sister institutions on climate induced disaster risk management.

7 Okyere KA & Jemaneh S, 2012. Increasing Agricultural Productivity & Enhancing Food Security in Africa: New Challenges and Opportunities. Synopsis of an international Conference. IFPRI. Washington D.C.

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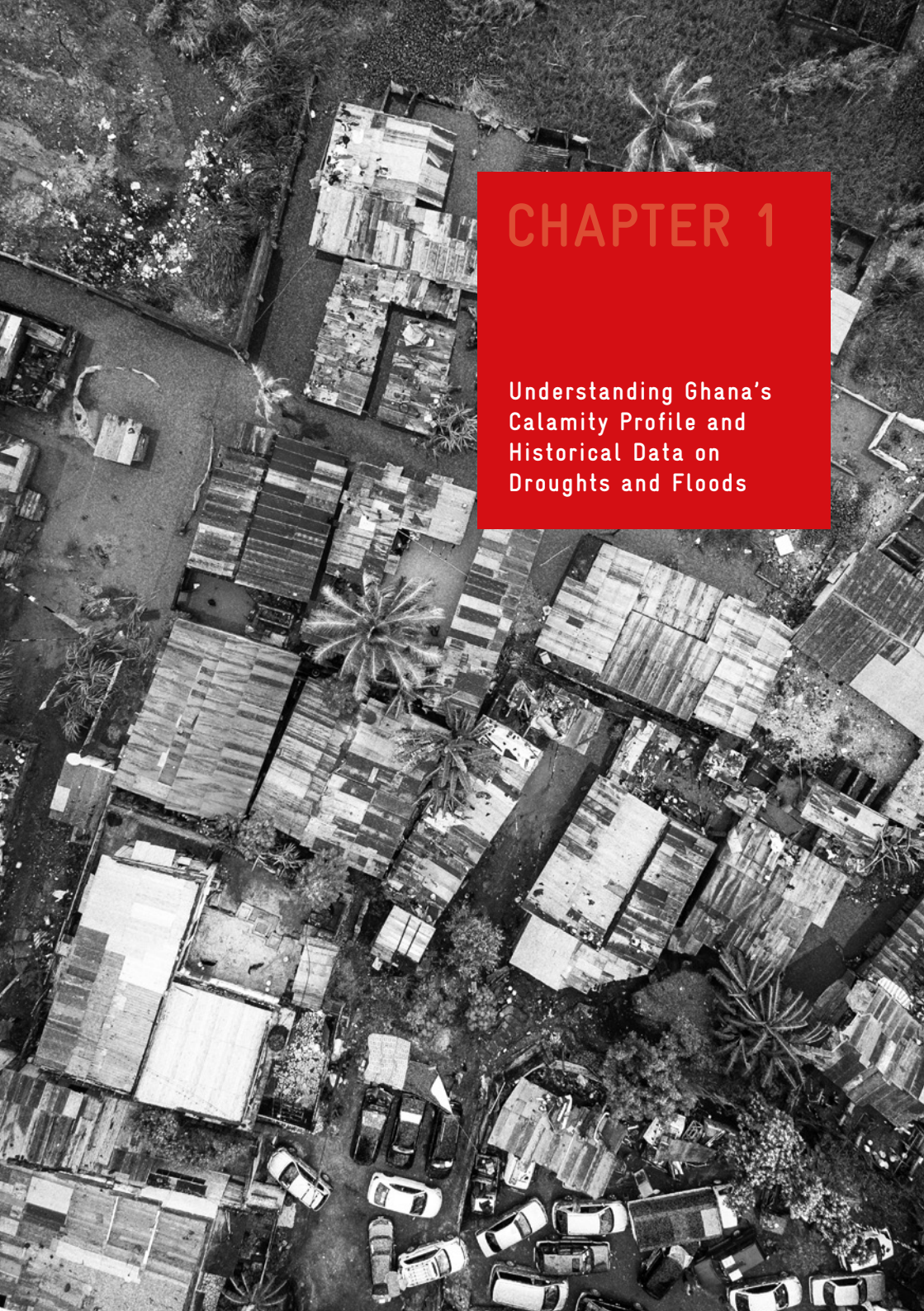


CHAPTER 1

Understanding Ghana's Calamity Profile and Historical Data on Droughts and Floods

This unit outlines issues regarding climate change and its physical evidence in Ghana, adaptation and mitigation strategies to combat the stresses of climate change and the importance of flood and drought forecasts to provide reliable early warning information towards minimizing the burdens of disasters resulting from such events.

LEARNING OBJECTIVES

The core objectives of this section is to help the participant to understand the following:

i. The fundamentals of weather, climate, climate change, adaptation and mitigation strategies;
ii. Effects of climate change – evidence and case study in Ghana;
iii. Adaptation and mitigation strategies to contain the effects of climate change and variability; and
iv. The importance of monitoring and forecasting droughts and floods.

1.1 THE CONCEPT OF WEATHER, CLIMATE, AND CLIMATE CHANGE IN GHANA

Weather is the day to day variation in atmospheric components; the combination of current meteorological parameters, such as temperature, precipitation amount and type, wind speed, wind direction, relative humidity, sun shine hours, etc. and has a relatively short temporal observation and characterization range, usually, up to several days. The average of these day-to-day observations over a long time domain is referred to as climate. Climate is a vital physical element which indicates the atmospheric condition of heat, moisture and energy, as well as, their circulation within the atmosphere. Climate is functional in vegetation and soil structuring, which have crucial impacts on life due to our vast dependencies on these.

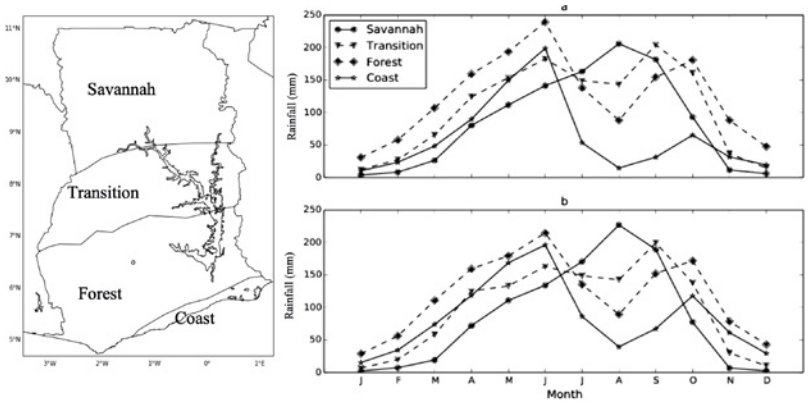
Table 1.1: Summary of the differences between weather and climate.

Weather	Climate
i. State of the physical conditions of the atmosphere at a particular place at a particular time	i. Long-term weather patterns of an area
ii. Controlled by solar energy which in turn controls winds which transport moisture, heat and energy around the planet	ii. Undergoes cyclic changes over decades, centuries and millennia

1.2 CLIMATE OF GHANA

The Ghanaian climate is typically monsoonal, with two main seasons (dry and wet) dominating the country, due to its location in the tropics.[8] The dry season is characterized by hotter temperatures and arid atmospheres whereas the wet season is dominated by moist atmospheres and temperatures less than the dry season. As shown in → Figure 1.1, unimodal rainfall patterns exist in the northern part of the country whereas a bimodal rainfall pattern exists in the southern part.[9,10,11]

Figure 1.1 Rainfall climatology of the four agro-ecological zones of Ghana, deduced from (a) station data and (b) GPCC data[12].



8 Aryee JNA, Amekudzi LK, Quansah E, Klutse NAB, Atiah WA, Yorke C (2018) Development of high spatial resolution rainfall data for Ghana. International Journal of Climatology 38(3):1201–1215

9 Aryee JNA, Amekudzi LK, Quansah E, Klutse NAB, Atiah WA, Yorke C (2018) Development of high spatial resolution rainfall data for Ghana. International Journal of Climatology 38(3):1201–1215

10 Sultan B, Janicot S. (2003) The West African Monsoon Dynamics part ii: Preonset and onset of the summer monsoon. J. Climate 16: 3407–3427.

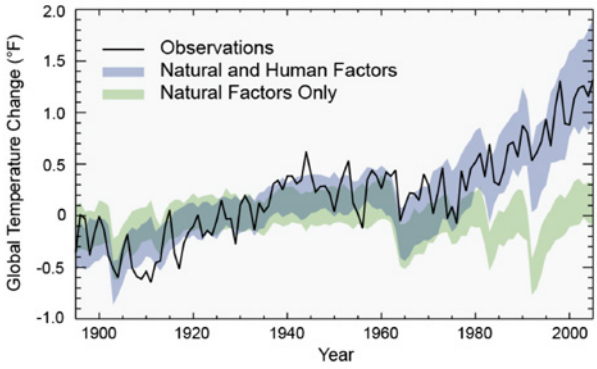
11 Amekudzi LK, Yamba E, Preko K, Asare EO, Aryee J, Baidu M, Codjoe NAS (2015) Variabilities in rainfall onset, cessation and length of rainy season for the various agro-ecological zones of Ghana. Climate 3:416–434.

12 Aryee JNA, Amekudzi LK, Quansah E, Klutse NAB, Atiah WA, Yorke C (2018) Development of high spatial resolution rainfall data for Ghana. International Journal of Climatology 38(3):1201–1215

Rainfall over the country is mainly linked to development and movement of Mesoscale Convective Systems (MCS), and regulated by advection of moisture in the lower levels of the atmosphere from the Gulf of Guinea. This system is driven by temperature and energy contrasts between the Sahara and Gulf of Guinea.[13] Along the Inter-Tropical Discontinuity (ITD), maritime tropical air mass from the Atlantic Ocean converges with dry and cold tropical continental air mass.[14] Additionally, Nicholson[15] highlights three quasi-independent mechanisms that regulate precipitation development over West Africa, namely ascent linked to the upper-level jet streams, convergence associated with the surface Inter-tropical Convergence Zone (ITCZ), and a coastal circulation cell linked to sea-breeze effects. These factors induce the generation of the tropical rain belt which migrates seasonally between the northern and southern halves of the continent.

1.3 TRIGGERS OF CLIMATE VARIABILITY AND CHANGE

Figure 1.2 The Contribution of Natural and Human Factors to the Global Temperature Change.[16]



13 Sultan B, Janicot S. (2003) The West African Monsoon Dynamics part ii: Preonset and onset of the summer monsoon. J. Climate 16: 3407–3427.

14 Amekudzi LK, Yamba E, Preko K, Asare EO, Aryee J, Baidu M, Codjoe NAS (2015) Variabilities in rainfall onset, cessation and length of rainy season for the various agro-ecological zones of Ghana. Climate 3:416–434. Nicholson SE. 2009. A revised picture of the structure of the monsoon and land ITCZ over West Africa. Climate Dynamics 32(7-8): 1155–1171.

15 Nicholson SE. 2009. A revised picture of the structure of the monsoon and land ITCZ over West Africa. Climate Dynamics 32(7-8): 1155–1171.

16 Adapted from https://19january2017snapshot.epa.gov/climatechange/climate-change-facts-answers-common-questions. Accessed 11 June, 2019.

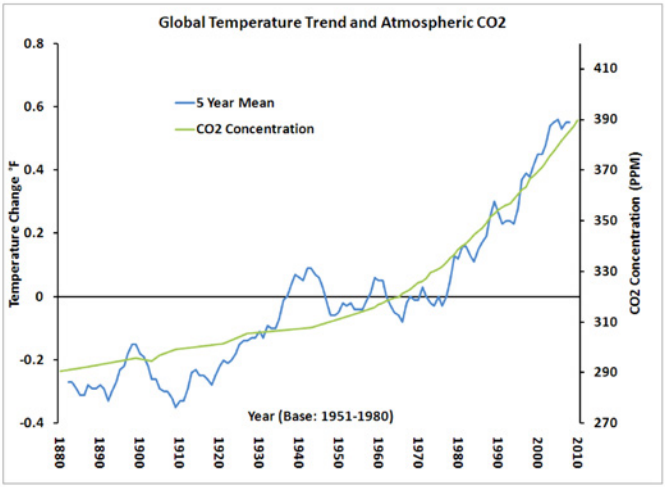
Over the years, evidence from global studies suggests that climate is changing. This changing climate is mainly observed (i) analytically, through changes in long-term means of the atmospheric variables as shown in → Figure 1.2 and (ii) physically through massive changes in the atmospheric variables as well as their related signals, such as heightened or reduced rainfall amounts and frequencies in various locations globally, global sea level rise, melting of ice caps, etc. These changes result in a variety of extreme weather events. With increases in global temperatures, processes such as desertification and droughts are gradually transforming once thriving areas into arid environments. And yet, since warm air is capable of holding far greater quantities of water, due to higher evaporation rates, storms and other extreme climate events have become more frequent and severe. In Ghana, climate change is equally made obvious through increased rates of climate-induced events, such as floods and droughts. These have been coupled with varying degrees of disasters such as loss of lives and properties, submerging of coastal and low-lying lands, drying up of some perennial rivers, etc.

Figure 1.3: Floods in major parts of Accra, Ghana that led to loss of lives and properties.[17, 18]

17 Adapted from https://www.sott.net/article/320011-1-missing-after-6-hours-of-torrential-rain-in-Accra-Ghana. Accessed 11 June 2019.
18 Adapted from https://ghiroph.com/cyclone-idai-kills-at-least-557-in-southern-africa. Accessed 11 June 2019.

Although climate naturally changes over time, these changes have been exacerbated by anthropogenic contributions through burning of bush and fossil-fuels, deforestation, land-use and land-cover change, industrialization, excessive use of pesticides and other agricultural chemicals. These activities emit **greenhouse gases (GHGs)** into the atmosphere, and thus exert positive and/or negative forcing on the atmosphere. These anthropogenic factors have massively warmed the earth's atmosphere beyond the industrialization era. The earth's natural processes, in its steady state, emit roughly the same amount of GHGs as its ecosystems absorb. However, human activities have almost doubled CO_2 concentration in the atmosphere since the Industrial Revolution (1960s), beyond what can be sequestered by the plants of the forests, grasslands, and oceans. Meanwhile, these plants and oceans which serve as carbon sinks are being depleted.

Figure 1.4: Global Temperature and Atmospheric Carbon Dioxide Trends [19]

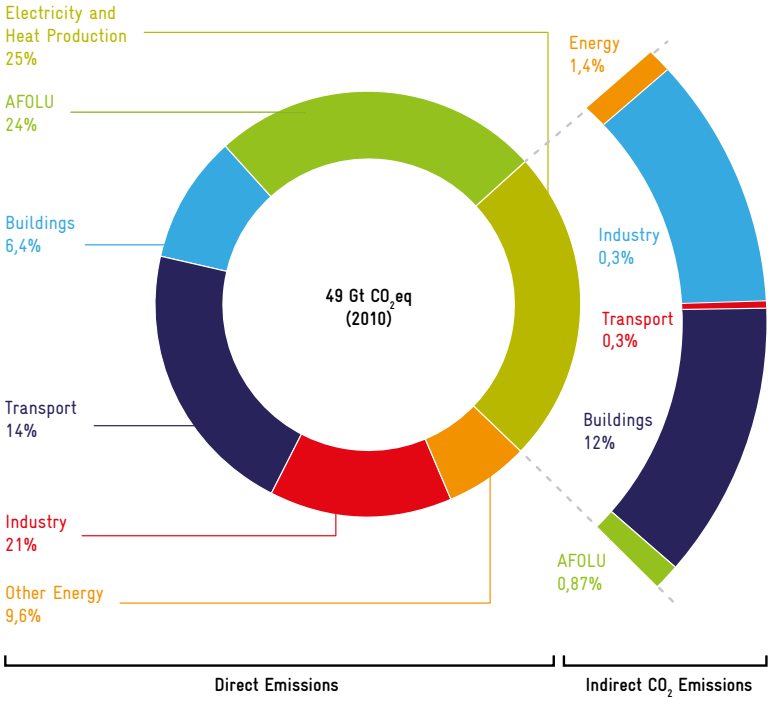


19 Adapted from http://www.enggcyclopedia.com/2012/05/carbon-capture-sequestration/. Accessed 11 June 2019.

A major role of anthropogenically-emitted GHGs is that they trap the outgoing longwave radiation and re-emit this back to the earth's surface, thereby warming the earth's surface and triggering changes in the climate of a domain; a phenomenon known as Global Warming. Per the USAID Greenhouse Gas Emissions Factsheet, emission of GHGs recorded a 20% surge from 1991 to 2011, and the energy intensity of the economy rose alongside the growing demand in industry, transport and households.

1.4 MAJOR SOURCES OF GREENHOUSE GASES IN GHANA

Figure 1.5: Global Greenhouse gas emissions by economic sector.[20]



20 Adapted from The Fourth IPCC report, 2014

In Ghana, the major sources of Greenhouse Gas emissions include, but are not limited to:

- Land use and land cover changes (especially, deforestation).
- Electricity/Power Generation
- Agriculture
- Transport
- Urbanization
- Industrialization

1.5 CLIMATE CHANGE: MYTHS AND FACTS

In the wake of changing climates globally, there exist 2 schools of thought which tend to disagree on various frontiers of the climate change debate. One school of thought argues that climate change is only but a myth and thus, these changes are bound to recover naturally without any human intervention. On the contrary, the second school of thought believes that climate change is real and thus, has to be addressed through the implementation of mitigation and adaptation measures targeted at reducing the anthropogenic influences which is the dominant driving force of the "fast-racing" climate change. Outlined below are some myths and facts of climate change:

1.5.1 Myths of Climate Change

1) Man-caused greenhouse gases are insignificant relative to naturally released greenhouse gases; thus, we humans are not the problem.
2) The increase in global temperature over the last 100 years was only about 1 °C, and if the temperature goes up a similar amount in the next 100 years, then it is no big deal.
3) Some scientists argue that the earth has the ability to naturally recover from any stress exerted on its systems.
4) Some scientists argue that global warming is a problem while others have contrary views. The science is still being debated, hence, there is no consensus.

1.5.2 Facts of Climate Change

1) Although climate has changed before, these changes are reactions to whatever forced them to change; humans are now the dominant forcing.
2) Carbon dioxide, amongst other GHGs, are rising and thus making global warming much worse. From the United Nations Framework Convention On Climate Change (UNFCCC) fact-sheet, Ghana has been estimated to emit alarming proportions of CO_2, resulting from our dependencies, such as energy generation, transportation, industrialization, etc.
3) Negative impacts of global warming on general livelihood and sustenance far outweigh any positives.
4) Rising CO_2 concentration increases atmospheric water vapour, which makes global warming much worse.
5) As a result of global warming, glaciers are in rapid retreat worldwide, which is of grave concern for humanity, since sea levels are rising and thus, more coastal habitats are being submerged.

Now, beyond the debate frontiers of whether climate change is a myth or fact, there is an intriguing and fascinating scenario, which is:

"You have to drive to another town, and amidst other alternatives, you decide to use a particular bridge. Now, 97% of experts say the bridge is going to collapse, 3% say "Don't Worry". Would you drive over the bridge?"

The real issue at hand is, when 97% of climate scientists agree that human-induced climate change is real, then it is worth listening to them. Moreover, numerous research studies have documented how Intergovernmental Panel on Climate Change (IPCC) predictions –the leading authority on the matter – are likely to underestimate rather than overstate the climate response and implications of this change, suggesting even greater need for action.

1.6 EFFECTS OF CLIMATE CHANGE – EVIDENCE AND CASE STUDY IN GHANA

Key sectors of Ghana's economy that are already been massively affected by climate change include:

1. Water Resources[21, 22]
2. Agriculture
3. Energy Production (e.g. low water levels in Akosombo dam) (Bekoe and Logah[23] attributed the energy crises of 1983, 1997 and 2006 to hydrological drought)
4. Community and Town Planning
5. Health
6. Education, etc.

Table 1.2: Climate change impact on various economic sector GDP losses[24]

Impact of climate change on …	2010 (% of GDP lost)	Description	2030 (% of GDP loss projected)	Description
… labour productivity	3.0	Acute	6.1	Acute
… fisheries	0.3	High	1.1	Acute
… agriculture	0.4	Severe	0.7	Acute
… sea level rise	0.3	Moderate	0.4	Moderate
… biodiversity	0.1	Moderate	0.2	High

(DARA and the Climate Vulnerable Forum, 2012)

21 Kankam-Yeboah, K., Amisigo, B., & Obuobi, E. (2011). Climate change impacts on water resources in Ghana.
22 Osei, M. A., Amekudzi, L. K., Wemegah, D. D., Preko, K., Gyawu, E. S., and Obiri-Danso, K. (2018) Hydro-Climatic Modelling of an Ungauged Basin in Kumasi, Ghana, Hydrol. Earth Syst. Sci.
23 Bekoe, O. E and Logah, F. Y. (2013): The Impact of Droughts and Climate Change on Electricity Generation in Ghana, CSIR-Water Research Institute, Accra.
24 DARA/Climate Vulnerable Forum. (2012). Climate vulnerability monitor: A guide to the cold calculus of a hot planet. Retrieved from http://www.daraint.org/wp-content/uploads/2012/10/CVM2-Low.pdf

As discussed in DARA and the Climate Vulnerable Forum,[25] climate change is projected to have a tremendous impact on the country's Gross Domestic Product (GDP). For example, the impact of climate change on labour productivity, biodiversity and agricultural losses is projected to double by 2030, whereas its impact on fishery losses is expected to triple by 2030. The climate-change induced sea-level rise losses are expected to moderately rise from 0.3 % to 0.4 % by 2030. These measures are strong indications of anticipated losses of the country, should adaptation and remediation strategies not be implemented.

1.7 DISASTER PROFILES IN GHANA: TREND OF FLOOD AND DROUGHT RELATED DISASTERS ETC.

Disasters, by definition, are serious disruptions of the functioning of communities or societies resulting in widespread human, material, economic or environmental losses which exceed the coping capacities of the affected community's own resources.[26] Disasters are only termed as such if 10 or more people are killed, 100 or more people are affected or a call of international assistance and/or a declaration of state of emergency is necessary.[27] Disaster results when a hazard with adverse effects occurs in a context of vulnerability. Over the years, Ghana has been plagued with disasters such as floods, droughts and fires. These events are mostly accompanied with adverse effect on human life, livelihood and property. Such disasters are either naturally-occurring or human-induced. For example, rainfall variability, driven by global and regional climatic processes accounted for the major droughts in 1982/83, 1992, 1997, 2001, 2007 and 2015/2016 in portions of the country and the sub-regions.

25 DARA/Climate Vulnerable Forum. (2012). Climate vulnerability monitor: A guide to the cold calculus of a hot planet. Retrieved from http://www.daraint.org/wp-content/uploads/2012/10/CVM2-Low.pdf

26 IFRC (International Federation of Red Cross and Red Crescent), 2007: World Disasters Report: Focus on Discrimination. Report.

27 UNISDR (Inter-Agency Secretariat of the International Strategy for Disaster Reduction), 2004: Living with Risk – A global review of disaster reduction initiatives.

1.7.1 Floods

Various events of flooding have been recorded over the entire country, accompanied by varying degrees of disaster, with the major disaster being that of June 3, 2015 when over a hundred lives were lost through floods in the area of the Kwame Nkrumah Circle, Accra, coupled with the explosion of a gas station. Some historical flood events, with their accompanying destruction, have been listed below.

Table 1.3: Some historical records of flooding in various parts of the country.

Date	Event
July 4, 1968	Accra registered a record rainfall of 12.7 cm in the last nine years.
June 29, 1971	Houses collapsed in Sekondi-Takoradi following a heavy downpour which commenced the previous night.
July 5, 1995	Flooding in low areas of Accra which also affected Achimota VRA substation, resulting in power cuts.
June 13, 1997	Intermittent downpour for two days in Accra caused floods, stalling productivity.
September 20–28,1999	Three hundred thousand (300,000) people affected by floods in the Upper West the Upper East and the Northern regions, as well as the northern parts of Brong Ahafo and Volta regions.
June 28, 2001	Early morning downpour submerged portions of the city, affecting many houses and other structures within Madina, Achimota, Dzorwulu, Avenor, Santa Maria, and Adabraka Official Town.
September, 2007	Flooding in three northern regions of Ghana – Upper East, Upper West and Northern Region – after droughts in early portions of the year. Floods were estimated to have affected 307,127 people, washing away homes, crops, livestock, collapsing bridges and destroying water systems.
June 3, 2015	Floods in major parts of Accra, coupled with explosion of a gas station claimed over 150 lives.

1.7.2 Droughts

Ghana has experienced droughts of various magnitudes as a country, with the major one in 1983 during which the countrywide vegetation was destroyed by raging bushfires, resulting in a massive famine.

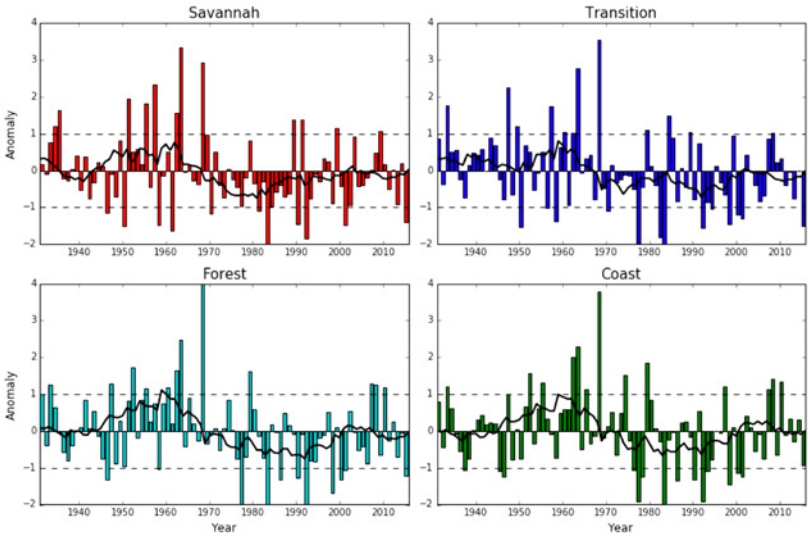
Similarly, the floods that occurred in the Northern parts of Ghana in 1999 were preceded by droughts which called for the provision of food for the affected people. The preceding drought and the abrupt end of the planting season yielded an inevitable situation of food insecurity by destroying the food reserves.

1.7.3 Earthquakes

In Ghana, earthquake hazard is classified as **medium**, which implies that there is a 10% chance of potentially-damaging earthquake shaking in the next 50 years. Although, several earth tremors have rocked some parts of the country, for example in 1615, 1636, 1862 and 1939, the possibilities of such occurrences in the next 50 years is only about 10%. Apart from drought and floods, Ghana has been spared other natural disasters such as major earth tremors since 1939, when the earth movement damaged houses in suburbs of Accra. Detailed write-up on earthquakes and landslides have been provided in → Module 3.

1.8 WHAT CLIMATE RECORDS PORTRAY FOR THE VARIOUS FLOOD AND DROUGHT EVENTS.

Figure 1.6: Standardized anomalies [bars] and 7-year moving averages [line] of annual rainfall totals in the four agro-ecological zones of Ghana.



Floods and droughts in Ghana have become perennial events, with the extent of their devastation and impact on human lives and sustenance being tremendous. Notwithstanding, these events can only be justified from climate records to substantiate the role of climate change in modulating these events: whether climate change wholly induces these events or not.

In this light, rainfall records from the 1930s to date were standardized using Standardized Precipitation Index (SPI) to monitor the yearly rainfall anomalies, in comparison to the climatological means for each agro-ecological zone. Flood (Drought) years, by this approach, were characterized by anomalies in the order of >1 (< -1). The following deductions were made:

i. Reduced frequency of wet years (SPI > 0.5), culminating into more dry years, especially from the late 1960s.

ii. Running means show a decline in rainfall climatologies of the first half, and a gradual but steady increase within the second phase.

iii. Observations of increasing precipitation trends within the pre-industrial era (before 1960) and a decreasing trend after the industrial era, especially in the Coast, Forest and Transition. Later phases (2000s), in the Savannah zone, seems to be yielding positive trends.

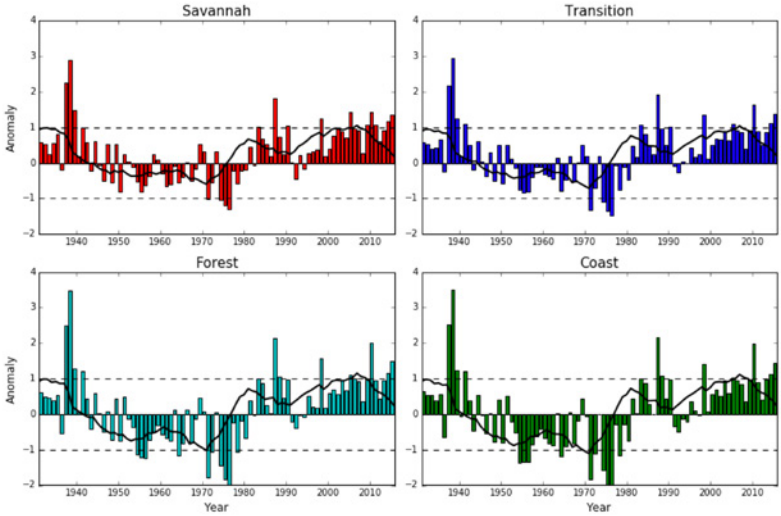
As shown in → Table 1.4, the historical flood years have been checked with rainfall anomaly profiles from → Figure 1.6, to identify and mark out possible climate-induced historical flood- and drought- years over the country.

Table 1.4: Review of historical floods and droughts, whether they were hugely climate-induced or not.

Flood Year	Climate Contribution
July, 1968 – Accra	Climate – Induced
July, 1995 – Accra	Not Climate – Induced
June, 1997 – Accra	Climate – Induced
1999 – U. West & East, Northern B. Ahafo, Volta	Climate – Induced
June, 2001 – Accra	Not Climate – Induced
2007 – U. West & East, Northern	Climate – Induced
June, 2010 – Accra	Climate – Induced
May 2005 – Accra	Not Climate – Induced
May-June 2010 – Various locations countrywide	Climate – Induced
February 2011 – Accra	Not Climate – Induced
July 2011 – Eastern	Not Climate – Induced
May 2013 – Accra	Not Climate – Induced
June-July, 2014 – Accra	Not Climate – Induced
June, 2015 – Accra	Not Climate – Induced
Drought Year	**Climate Contribution**
1983	Climate – Induced
1999 - Northern Ghana	Not clear

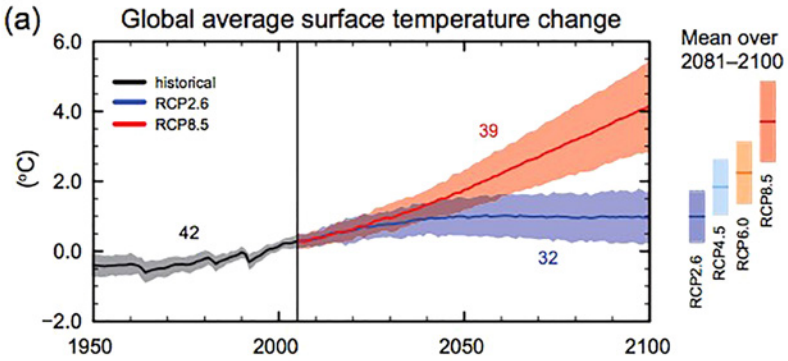
Other drought years identified from the records include 1977, 1992 and early 2000s over the entire country. Further explanation to this has been provided in → Module 3.

Figure 1.7 Standardized Anomalies [bar] and 7-year moving averages [line] of mean annual surface air temperature in the four agro-ecological zones of Ghana.



The temperature profiles, as depicted in → Figure 1.7, show warmer surface profiles in the early decade, which were succeeded by a long-phase (approximately three decades) of temperatures colder than normal temperatures, and subsequently, warmer surface temperatures from the 1980s to date. A notable and intriguing feature over all four agro-ecological zones of the country is the continuous and steady rise in temperature anomalies in the last twenty (20) years. Should these trends continue, without any remediation plan for anthropogenic-inducing factors, then there is a great cause for alarm, since these gradual temperature surges are likely to influence other external factors, such as storm frequency and intensity, etc. Projections of the Intergovernmental Panel on Climate Change (IPCC), with regards to global temperature changes, suggest that global temperatures have already risen by 0.8 °C, and under different scenarios of greenhouse gas emissions, temperatures are likely to increase by about 1.5 °C to 4.5 °C within the next century (→ see Figure 1.8).

Figure 1.8: Projected changes in global annual mean surface temperature relative to 1986–2005.[28]



28 „IPCC, Climate Change 2013: The Physical Science Basis – Summary for Policymakers (AR5 WG1)". p. 17.

1.9 EVIDENCE OF CLIMATE CHANGE IN GHANA[29, 30, 31, 32]

Figure 1.9: Evidence of climate change in Ghana (floods, drought, drying of perennial rivers, water-level surges, etc.)

Evidence of urban flooding

Evidence of river flooding

Evidence of drought

29 Adapted from https://www.graphic.com.gh/features/opinion/floods-in-ghana-the-need-to-avert-future-disasters.html. Accessed 11 June 2019.
30 Adapted from https://www.africanriskcapacity.org/product/river-flood/. Accessed 11 June 2019.
31 Adapted from https://www.dhigroup.com/global/news/2017/03/improving-the-livelihoods-of-farmers-in-ghana. Accessed 11 June 2019.
32 Adapted from https://www.graphic.com.gh/news/general-news/degraded-land-in-upper-east-region-to-be-restored.html. Accessed 11 June 2019.

1.10 WHY SHOULD CLIMATE CHANGE BE EVERY GHANAIAN'S BUSINESS?

The following are only but a few reasons why climate change must be a concerted effort of each and every Ghanaian. These include, but are not limited to the following:

(a) Every Ghanaian is directly or indirectly affected by the raging consequences of climate change.

(b) Climate change is also a developmental problem; not just environmental and its impacts are being felt now.

(c) Developing countries, such as Ghana, are more vulnerable despite climate change affecting every country.

(d) Every Ghanaian can make that difference.

1.11 CLIMATE CHANGE MITIGATION AND ADAPTATION

There is the necessity to act quickly in order to curb the irreversible greenhouse gas build-up and global warming at potentially huge costs to worldwide economies. Response to climate change involves:

(i) reducing and stabilizing the levels of heat-trapping greenhouse gases in the atmosphere **(mitigation)** and/or

(ii) adapting to the already occurring climate change **(adaptation)**.

1.11.1a What is Climate Change Adaptation?

Several definitions for climate change adaptation exist. Of the lot, four of such definitions which emphasize the contributions of human actions or inactions to climate change adaptation measures are outlined below, as:

i. **Adjustment in natural or human systems in response** to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities.[33]

ii. **Practical steps to protect** countries and communities from the likely disruption and damage that will result from effects of climate change.[34]

iii. A process by which **strategies to moderate, cope with and take advantage** of the consequences of climatic events are enhanced, developed, and implemented.[35]

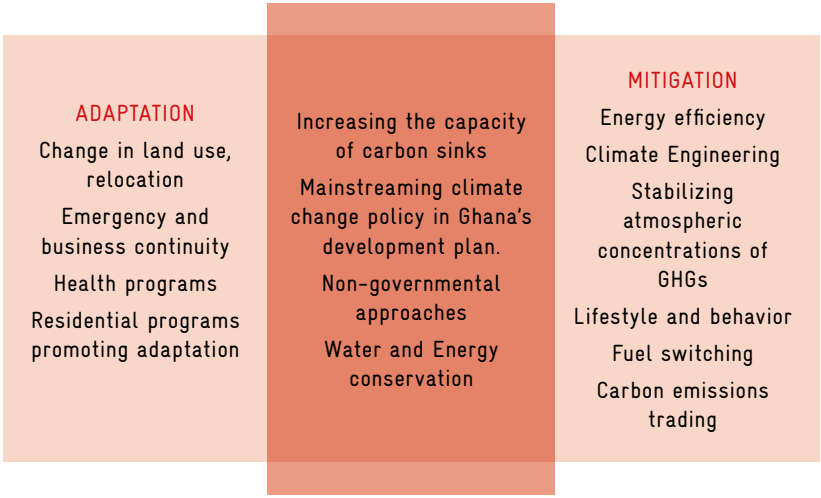
iv. The process or outcome of a process that leads to a **reduction in harm or risk of harm, or realization of benefits** associated with climate variability and climate change.[36]

33 IPCC TAR, 2001 a. Climate Change 2001: Impacts, Adaptation and Vulnerability. IPCC Third Assessment Report, Cambridge University Press.
34 UNFCCC, 1992: United Nations Framework Convention on Climate Change.
35 Lim, B and E. Spanger-Siegfried (eds), I.Burton, E. Malone, S. Huq, 2005: Adaptation Policy Frameworks for Climate Change. Developing Strategies, Policies and Measures, UNDP.
36 UKCIP , 2004: Costing the impacts of climate change in the UK, Oxford UK.

1.11.1b What is Climate Change Mitigation?

Climate Change Mitigation involves actions targeted at limiting the magnitude or rate of long-term Climate Change, through reduction of human-induced global warming or increasing the carbon sink capacity.[37, 38, 39]
Climate Change Mitigation also implies, utilizing modern technologies and renewable energies, improving energy efficiency of older equipment, or changing management practices or consumer behaviour.

Figure 1.10: Climate Change Adaptation and Mitigation Measures.



37 Fisher, B. S.; et al., „Ch. 3: Issues related to mitigation in the long-term context", Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007, 3.5 Interaction between mitigation and adaptation, in the light of climate change impacts and decision-making under long-term uncertainty, in IPCC AR4 WG3 2007.

38 IPCC, „Summary for Policymakers", Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, 2007, Human and Natural Drivers of Climate Change, in IPCC AR4 WG1 2007.

39 Oppenheimer, M., et al., Section 19.7.1: Relationship between Adaptation Efforts, Mitigation Efforts, and Residual Impacts, in: Chapter 19: Emergent risks and key vulnerabilities (archived July 8 2014), pp. 46–49, in IPCC AR5 WG2 A 2014.

1.11.2 Types of Climate Change Adaptation

Adaptations may involve the development or adoption of a technology, or it can involve building capacity such as improved risk management or knowledge enhancement.[40] Various types of adaptation can be identified, which include:

i. Anticipatory and Reactive Adaptation

Anticipatory Adaptation involves preparing and implementing climate change action plans to mitigate greenhouse gas emissions and reduce the stresses associated with potential effects of climate change.[41] Such measures are built on the basis that climate change is likely to occur, and as such, these measures that would be taken in response to climate change are "no regret" measures that will produce benefits even if climate does not change. On the other hand, reactive adaptation involves adaptation measures that take place after impacts of climate change have been observed.[42] Reactive adaptation serves the purpose of regaining stability and is usually not the best response when historical understanding does not correspond with current environmental and socio-economic conditions.

ii. Private and Public Adaptation

Private Adaptation is initiated by individuals, households or private institutions and is mostly in the person's rational self-interest whereas **Public Adaptation** is initiated by government at all levels and is usually channelled at collective needs.[32]

Private Adaptation actions often accrue benefits directly back to the adaptor, and seldom accrue for others. Such actions include insulating homes, installing double glazing, or relocating out of an area prone to flooding.[43]

40 West, C. C. and Gawith, M. J., 2005. Measuring Progress: Preparing for Climate Change through the UK Climate Impacts Programme. UKCIP Technical Report. UKCIP, Oxford. p. 71.
41 Smith, J. B., Ragland, S. E. and Pitts, G. J. (1996) A process for evaluating anticipatory adaptation measures for climate change. Water, Air and Soil Pollution, 92 (1-2): pp. 229 – 238.
42 IPCC TAR, 2001 a. Climate Change 2001: Impacts, Adaptation and Vulnerability. IPCC Third Assessment Report, Cambridge University Press.
43 Tompkins, E. L., and H. Eakin. 2012. Managing private and public adaptation to climate change. Global Environmental Change 22(1):3-11. http://dx.doi.org/10.1016/j.gloenvcha.2011.09.010.

For **Public Adaptation**, measures such as planning exercises and expenditures of public funds on adaptation activities are employed to ameliorate the expected threats to public infrastructure and public goods associated with climate change (e.g., rising sea levels, drought), coupled with the contractual obligation of governments to protect their citizens from unreasonable harm.[33] The gains from these investments are non-rival, and non-payers cannot be excluded from enjoying the benefits.

iii. Autonomous and Planned Adaptation

Autonomous Adaptation (also termed spontaneous adaptation) is an adaptation strategy that constitutes not of a conscious response to climatic stimuli but is triggered by ecological changes in natural systems and by market or welfare changes in human systems. On the contrary, **Planned Adaptation** is the result of deliberate policy decision, based on awareness that conditions have been altered or are about to change, and that action is required to return to, maintain, or achieve a desired state.[44]

1.11.3 Why the Need to Adopt Climate Change Adaptation and Mitigation Measures

Extreme events, such as floods, droughts and heavy precipitation events, are expected to rise even with relatively small average temperature increases, due to Global Warming and Climate Change. Changes in some extreme events have already been observed; for example, increases in the frequency and intensity of heat waves and heavy precipitation events.[45]

44 IPCC TAR, 2001 a. Climate Change 2001: Impacts, Adaptation and Vulnerability. IPCC Third Assessment Report, Cambridge University Press.

45 Meehl, G.A.; et al., „Ch. 10: Global Climate Projections", Climate Change 2007: Working Group I: The Physical Science Basis, FAQ 10.3: If Emissions of Greenhouse Gases are Reduced, How Quickly do Their Concentrations in the Atmosphere Decrease?, in IPCC AR4 WG1 2007, pp. 824–825.

In most areas in Africa, floods and droughts can occur within months of each other and these events can lead to famine and widespread disruption of socio-economic well-being. In order to cope with the accompanying stresses and burdens of such extreme events, there is the need to implement adaptation measures to combat such occurrences. In addition, adaptation is especially important in developing countries since they are predicted to bear the brunt of the effects.[46]

1.11.4 Fundamental Principles to be Considered When Designing Climate Change

Adaptation and Mitigation Policy

According to Scheraga and Grambsch,[47] the following are the fundamental principles to be considered when designing a climate change adaptation policy:

i. The effects of climate change vary by region;

ii. The effects of climate change may vary across demographic groups;

iii. Climate change poses both risks and opportunities;

iv. The effects of climate change must be considered in the context of multiple stressors and factors, which may be as important to the design of adaptive responses as the sensitivity of the change;

v. Adaptation comes at a cost;

46 Schneider SH, Semenov S, Patwardhan A, Burton I, Magadza CHD, Oppenheimer M, Pittock AB, Rahman A, Smith JB, Suarez A, Yamin F (2007) Assessing key vulnerabilities and the risk from climate change. In Parry ML, Canziani OF, Palutikof J P, van der Linden PJ, HansonCE (eds) Climate change 2007: impacts, adaptation and vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, pp. 779–810.

47 Scheraga, J.D. and A.E. Grambsch (1998). Risks, opportunities and adaptation to climate change. Climate Research 10: 85–95. DOI: 10.3354/cr011085.

vi. Adaptive responses vary in effectiveness, as demonstrated by current efforts to cope with climate variability;

vii. The systemic nature of climate impacts complicates the development of adaptation policy;

viii. Maladaptation can result in negative effects that are as serious as the climate-induced effects that are being avoided; and

ix. Many opportunities for adaptation make sense whether or not the effects of climate change are realized.

1.11.5 Adaptation options and mitigation measures required across the key economic sectors of Ghana

Adaptation measures should be targeted in response to climate change, with focus on ameliorating the vulnerabilities of society and systems to these rapid and sudden changes. Such measures should therefore be more of a collective effort than an individualistic approach. Things we can do individually, regionally, at community or national level, to adapt to or mitigate the impacts of climate change on the various sectors of the country's economy include, but are not limited to:

i. Being advocates of environmentally friendly alternatives / lifestyles;

ii. Adopting smart agriculture and avoiding the cut and burn approach which releases carbon dioxide;

iii. Growing more trees to improve the existing carbon sinks;

iv. Limit flood hazards by adopting more economically-friendly waste management techniques, than improper disposal;

v. Building flood walls / defences around waterways, moving human settlements out of flood plains and other low-lying areas;

Figure 1.11: Tree planting exercise to protect Tano river.[48]

vi. Mainstreaming climate change policy in Ghana's development plan; and

vii. Policy actions as stipulated in the Ghana National Climate Change Policy Programme for Implementation: 2015–2020 need to be revisited and executed:

a) Developing climate-resilient agriculture and food security systems
b) Building climate-resilient infrastructure
c) Increasing resilience of vulnerable communities to climate-related risks
d) Improving management and resilience of terrestrial, aquatic and marine ecosystems
e) Addressing the impact of climate change on human health
f) Minimizing the impact of climate change on access to water and sanitation
g) Minimizing greenhouse gas emissions.

48 Adapted from https://www.graphic.com.gh/news/general-news/tree-planting-exercise-held-to-protect-tano-river.html. Accessed 11 June 2019.

1.11.6 Key Barriers to Adaptation

1. Information and Communication Systems
2. Technology
3. Economic Capacity
4. Infrastructure
5. Socio-cultural Perspectives
6. Conflicts
7. Gender Issues
8. Illiteracy
9. Incentives

1.12 FLOOD AND DROUGHT MONITORING AND FORECASTING: IMPORTANCE

In the wake of the excessive stresses -both directly and indirectly- linked with drought and flood events, and the weight of recovery, it is essential to adequately monitor flood and drought events and also provide forecasts of the sort to help in the provision of early warning systems and expansion of recovery capacity to help ease the related stresses of such events. A crucial point to note is that, recovery after flood- and drought-disasters is usually hectic, and requires much more resources than putting in place adequate preparation to ameliorate the burdens of these disasters. There is therefore the need to issue early warning system that will serve both the interests of inhabitants of flood- and drought-prone areas, as well as help the necessary disaster control body (NADMO) to map out such potential threat zones and readily respond with ease in the occurrence of such events. Nonetheless, a major limitation to effective spatial mapping of flood- and drought-prone areas is the **sparse distribution** of in situ observation network.[49]

49 Aryee JNA, Amekudzi LK, Quansah E, Klutse NAB, Atiah WA, Yorke C (2018) Development of high spatial resolution rainfall data for Ghana. International Journal of Climatology 38(3):1201–1215

Hence, alternative approaches such as radars, satellite data and modelling tools should be used to efficiently and effectively provide precise information on flood and drought-prone areas. Consequently, there is a necessity for NADMO-GMet collaborations, in this regard, to aid in the mapping and forecasting of potential flood and drought periods. These will help in effective monitoring, issuance of early warning systems and rapid response measures to reduce the extent of damage in such events. Detailed information has been provided in → Module 3.

SUMMARY

To conclude, climate change is real and it has massive repercussions on human lives and properties.

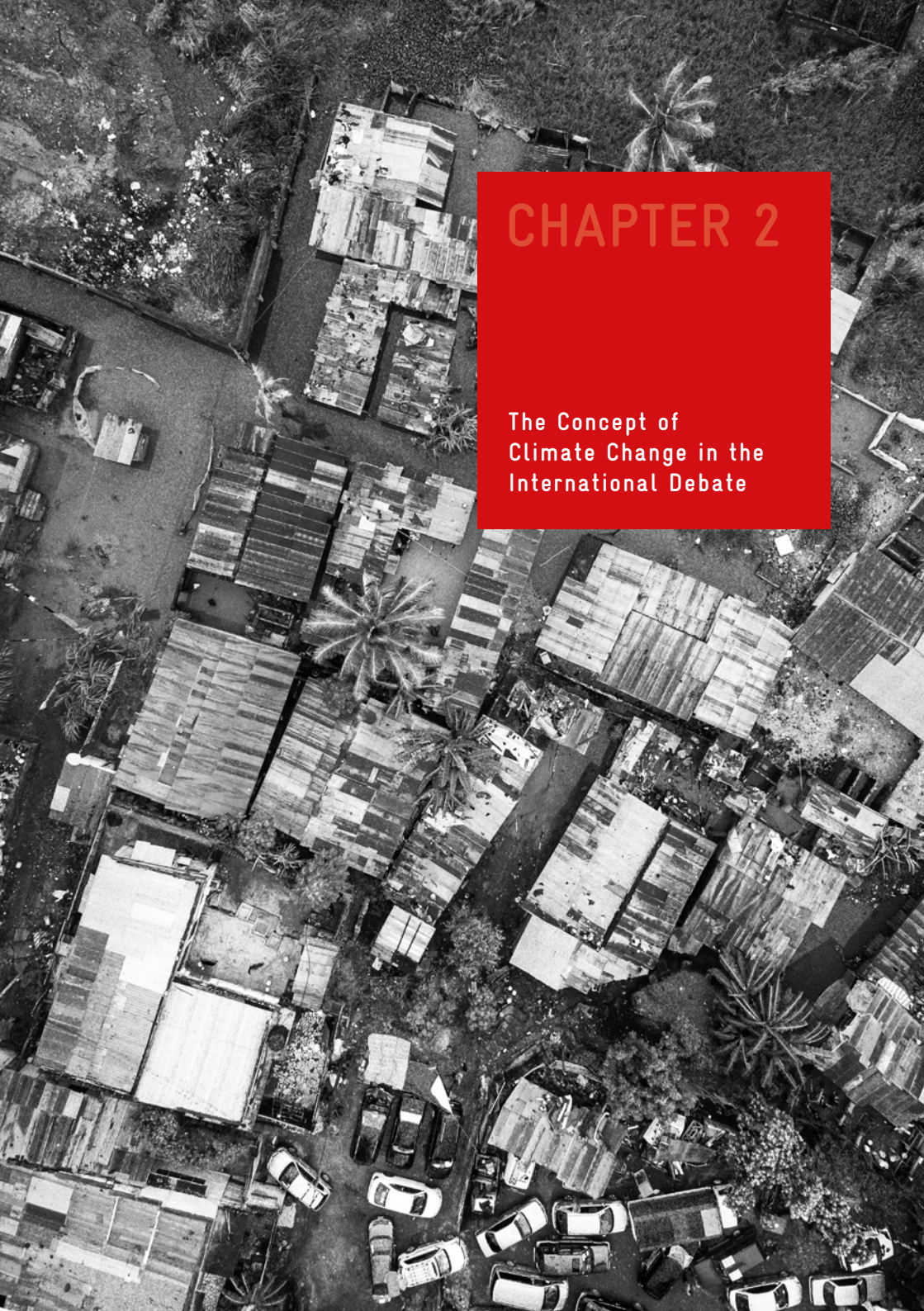
Despite these, climate change cannot be over-emphasized as the main cause of flood- and drought- disasters although it is a driving factor. The major contributor has got to do with our very own lifestyle, planning measures, preparedness for such disasters and our capacities to handle such disasters at all levels (community, regional, national).

The disaster rates are exacerbated by impeding the natural flow by reason of any action or inaction from humans such as:

- Building in waterways;
- Improper planning of the communities;
- Improper waste disposal (especially plastic waste, which takes a longer time to decompose and thus forms layers within water bodies, thereby obstructing the natural water flow); and
- Destroying the carbon sinks (e.g. deforestation).

If all GHG emission activities are stalled, it will take the earth a large number of years to get back to its original state. Nonetheless, if no action is taken, we amplify the negative effects of climate change, which already outweigh the positives.

The most reliable solution we can embrace to reduce the related stresses of projected climate change is **climate change adaptation and mitigation**.



CHAPTER 2

The Concept of Climate Change in the International Debate

This unit outlines the concept of climate change in international debates.

LEARNING OBJECTIVES

The objectives of this section is to enable the participant to take a grip on the concept of climate change by taking them through the following;

i. Discussion of argument for and against Climate Change;
ii. The United Nations Framework Convention On Climate Change (UNFCCC);
iii. Intergovernmental Panel On Climate Change (IPCC);
iv. International groups and agreements;
v. Sendai framework;
vi. Warsaw International Mechanism (WIM) for loss and damage; and
vii. Other protocols and agreements and timelines.

2.1 DISCUSSION OF ARGUMENT FOR AND AGAINST CLIMATE CHANGE

The global warming controversy concerns the public debate over whether climate change and/or global warming is occurring, how much has occurred in modern times, what has caused it, what its effects impact will be, whether any action should be taken to curb it, and if so what that action should be. Among scientists, there is a strong consensus that global surface temperatures have increased in recent decades and that the trend is caused by human-induced emissions of greenhouse gases.[50, 51] Political and popular debate concerning the existence and cause of climate change includes the reasons for the increase seen in the instrumental temperature record, whether the warming trend exceeds normal climatic variations, and whether human activities have contributed significantly to it. Scientists have resolved these questions decisively in favour of the view that the current warming trend exists and is ongoing, that human activity is the cause, and that it is without precedent in at least 2000 years. No scientific body of national or international standing disagrees with this view.

50 „IPCC, Climate Change 2013: The Physical Science Basis – Summary for Policymakers (AR5 WG1)" (PDF). p. 17.
51 3. Cook, J., Oreskes, N., Doran, P.T., Anderegg, W.R., Verheggen, B., Maibach, E.W., Carlton, J.S., Lewandowsky, S., Skuce, A.G., Green, S.A. and Nuccitelli, D., 2016. Consensus on consensus: a synthesis of consensus estimates on human-caused global warming. Environmental Research Letters, 11(4), p.048002.

2.2 EVIDENCE OF CLIMATE CHANGE

2.2.1 Global Warming (Temperature rise)

Global warming can be referred to as the observed century-scale rise in the average temperature of the world's climate climate system and the effects of this change. According to the Fifth Assessment Report (AR5) of the Intergovernmental Panel on Climate Change, „It is *extremely* likely that human influence has been the dominant cause of the observed warming since the mid-20th century".[52]
The largest influence by humans has been the emission of greenhouse gases (GHG), such as Carbon dioxide andmethane. With the continued emission of GHGs, the atmosphere is expected to warm further.

2.2.2 Melting of the Polar Ice

Melting of the Polar ice is a direct impact of global temperature rise (Global Warming). This leads to the increase in the volume of water in the oceans.[53] This increase in volume of the oceans has direct impacts on livelihoods.

52 IPCC, Climate Change 2013: The Physical Science Basis – Summary for Policymakers (AR5 WG1)" (PDF). p. 17.
53 Chen, J.L., Wilson, C.R. and Tapley, B.D., 2006. Satellite gravity measurements confirm accelerated melting of Greenland ice sheet. science, 313(5795), pp.1958-1960.

2.2.3 Sea level rise

Sea level rise is the increase in the volume of water in the oceans. This may be due to the increase in the thermal capacity of the oceans and the melting of the sea ice.[54, 55] Sea level rise will lead to coastal flooding thereby affecting properties and lives.

2.2.4 Frequency of Tropical Storms

Tropical storms threaten the livelihood of people and destruction of properties. The frequency of these storms have increase with the increase in global temperature. The 2017 Atlantic hurricane season was a hyperactive and catastrophic hurricane season, featuring 17 named storms, 10 hurricanes and 6 major hurricanes – ranking it alongside 1936 as the fifth-most active season since records began in 1851.

2.2.5 Ozone depletion

Ozone layer depletion, is simply the wearing out of the amount of ozone in the stratosphere. This process has mainly been attributed to human activities. The main cause of ozone depletion and the ozone hole is man-made chemicals, especially man-made halocarbon refrigerants, solvents, propellants, and foam-blowing agents (chlorofluorocarbon (CFCs), HCFCs, halons), referred to as ozone-depleting substances (ODS).[56, 57]

54 Nicholls, R.J., Hoozemans, F.M. and Marchand, M., 1999. Increasing flood risk and wetland losses due to global sea-level rise: regional and global analyses. Global Environmental Change, 9, pp.S69-S87.
55 Intergovernmental Panel on Climate Change, 2015. Climate change 2014: mitigation of climate change (Vol. 3). Cambridge University Press.
56 Intergovernmental Panel on Climate Change, 2015. Climate change 2014: mitigation of climate change (Vol. 3). Cambridge University Press.
57 Ravishankara, A.R., Daniel, J.S. and Portmann, R.W., 2009. Nitrous oxide (N2O): the dominant ozone-depleting substance emitted in the 21st century. science, 326(5949), pp.123-125.

2.2.6 Floods

Recent flood occurrence in the country has raised much concern about the changing climate.[58] Floods in Accra in 2015, 2016 and 2017 have claimed life and caused the destruction of properties worth millions of dollars. With climate change and global warming, the amount of precipitation is expected to change and may affect flooding.[59]

2.3 INTERNATIONAL GROUPS AND AGREEMENTS

Over the years, there have been international agreements and treaties signed by governments to help curb the situation. Various organizations have also been formed in this regard. Here, we document the major forms of treaties, their organizations and the motives for their formation.

2.3.1 The United Nations Framework Convention On Climate Change UNFCCC

The **UNFCCC** is an international environmental treaty adopted on 9 May 1992 and opened for signature at the Earth Summit in Rio de Janeiro from 3 to 14 June 1992. After a sufficient number of countries had ratified it, the treaty entered into force on 21 March 1994. The UNFCCC has nearly universal membership with 197 parties. The treaty is a parent treaty of the Kyoto protocol which has been ratified by 192 UNFCCC parties.

58 Karley N. K. Flooding and physical planning in urban areas in west africa: situational analysis of Accra, Ghana. Theoretical and Empirical Researches in Urban Management, (13):25, 2009.

59 Intergovernmental Panel on Climate Change, 2015. Climate change 2014: mitigation of climate change (Vol. 3). Cambridge University Press.

The UNFCCC objective is to „stabilize greenhouse gases concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system“ [60] [61] After the signing of the agreement, parties have met at conferences to discuss how to achieve the aims of the Framework Convention. An example is the conference that led to the Kyoto Protocol.[62]
The purpose of the Kyoto Protocol was to set new emission targets for developed countries since the previous was “not adequate”. The Kyoto protocol has had two commitment periods. The first from 2008–2012 and the second from 2013–2020 (which has not entered into force). There are now 195 Parties to the Convention and 192 Parties to the Kyoto Protocol. The Protocol entered into force on 16 February 2005. Since then, the Protocol the Parties to the Protocol have continued the negotiations and have amended the Protocol to achieve more ambitious results by 2030.

In 2011, parties adopted the „Durban Platform for Enhanced Action“.[63]
As part of the Durban Platform, parties have agreed to „develop a protocol, another legal instrument or an agreed outcome with legal force under the Convention applicable to all Parties“. At Durban and Doha, parties noted „with grave concern“ that current efforts to hold global warming to below 2 or 1.5 °C relative to the pre-industrial level appear inadequate. In 2015, all (then) 196 then parties to the convention came together for the UN Climate Change Conference in Paris 30 November–12 December and adopted by consensus the Paris Agreement, aimed at limiting global warming to less than 2 °C, and pursue efforts to limit the rise to 1.5 °C Celsius.
The Paris Agreement entered into force on November 4, 2016.[64]

60 Sands, P., 1992. The United Nations framework convention on climate change. Review of European, Comparative & International Environmental Law, 1(3), pp.270-277.
61 Bodansky, D., 1993. The United Nations framework convention on climate change: a commentary. Yale J. Int'l L., 18, p.451.
62 Grubb, M., Vrolijk, C. and Brack, D., 1997. The Kyoto Protocol: a guide and assessment. Royal Institute of International Affairs Energy and Environmental Programme.
63 Rajamani, L., 2012. The Durban platform for enhanced action and the future of the climate regime. International & Comparative Law Quarterly, 61(2), pp.501-518
64 1. Oppenheimer, M. and Petsonk, A., 2005. Article 2 of the UNFCCC: historical origins, recent interpretations. Climatic change, 73(3), pp.195-226.

2.3.2 Intergovernmental Panel on Climate Change (IPCC)

The **IPCC** is a scientific and intergovernmental body under the auspices of the United Nations, set up at the request of member governments, dedicated to the task of providing the world with an objective, scientific view of climate change and its political and economic impacts. It was first established in 1988 by two United Nations organizations, the World Meteorological Organization (WMO) and the United Nations Environment Programme (UNEP), and later endorsed by the United Nations General Assembly through Resolution 43/53. Membership of the IPCC is open to all members of the WMO and UNEP. The IPCC produces reports that support the United Nations Framework Convention on Climate Change (UNFCCC), which is the main international treaty on climate change.[65, 66]

The aims of the IPCC are to assess scientific information relevant to:

iii. Human-induced climate change,

iv. The impacts of human-induced climate change, and

v. Options for adaptation and mitigation.

There are several major groups under the IPCC.
These groups have been elaborated below.

65 Change, O.C., 2007. Intergovernmental panel on climate change. In World Meteorological Organization. Disponible en: http://wmo. insomnation. com/sites/default/files/documents/meetings/session20/doc2. pdf.
66 Intergovernmental Panel on Climate Change, 2015. Climate change 2014: mitigation of climate change (Vol. 3). Cambridge University Press.

IPCC Panel meets in plenary session about once a year and controls the organization's structure, procedures, and work program. The Panel is the IPCC corporate entity.
Chair: Elected by the Panel.

Secretariat oversees and manages all activities. Supported by UNEP and WMO.

Bureau: Elected by the Panel. Chaired by the Chair. 30 members include IPCC Vice-Chairs, Co-Chairs and Vice-Chairs of Working Groups and Task Force.

Working Groups: Each working group has two Co-Chairs, one from the developed and one from developing world, and a technical support unit.

> **Working Group I:** Assesses scientific aspects of the climate system and climate change.
> **Working Group II:** Assesses vulnerability of socio-economic and natural systems to climate change, consequences, and adaptation options.
> **Working Group III:** Assesses options for limiting greenhouse gas emissions and otherwise mitigating climate change.
> Task Force on National Greenhouse Gas Inventories.

IPCC Assessment Reports

The IPCC has published five comprehensive assessment reports reviewing the latest climate science, as well as a number of special reports on particular topics. These reports are prepared by teams of relevant researchers selected by the Bureau from government nominations. Expert reviewers from a wide range of governments, IPCC observer organizations and other organizations are invited at different stages to comment on various aspects of the drafts. Each assessment report is in three volumes, corresponding to Working Groups I, II and III. Unqualified, „the IPCC report" is often referred to the Working Group I report, which covers the basic science of climate change.[67]

67 Intergovernmental Panel on Climate Change, 2015. Climate change 2014: mitigation of climate change (Vol. 3). Cambridge University Press.

2.3.2.1 First Assessment Report

The IPCC first assessment report was completed in 1990, and served as the basis of the UNFCCC.

They are certain that emissions resulting from human activities are substantially increasing the Atmospheric concentrations of the greenhouse gases, resulting on average in an additional warming of the Earth's surface.

They calculate with confidence that CO_2 has been responsible for over half the enhanced greenhouse effect.

They predict that under a „business as usual" (BAU) scenario, global mean temperature will increase by about 0.3 °C per decade during the 21st century.

They judge that global mean surface air temperature has increased by 0.3 to 0.6 °C over the last 100 years, broadly consistent with prediction of climate models, but also of the same magnitude as natural climate variability.[68]

68 15 UNFCCC Article 4: Commitments, paragraph 7 (https://web.archive.org/web/20110124034306/https://unfccc.int/essential_background/convention/background/items/1362.php), archived from the original (http://unfccc.int/essential_background/convention/background/items/1362.php) on 24 January 2011, in United Nations 1992.

2.3.2.2 Second Assessment Report

The IPCC Second Assessment Report (AR2), Climate Change 1995, was finished in 1996. It is split into:

- A synthesis to help interpret UNFCCC article 2, the "Science of Climate Change" (WG I), and "Impacts, Adaptations and Mitigation of Climate Change" (WG II); and
- A Summary for Policymakers (SPM) that represents a consensus of national representatives.

It confirms that Greenhouse gas concentrations have continued to increase, anthropogenic aerosols tend to produce negative radiative forcing, and climate has changed over the past century (air temperature has increased by between 0.3 and 0.6 °C since the late 19th century.

The balance of evidence suggests a discernible human influence on global climate (considerable progress since the 1990 report in distinguishing between natural and anthropogenic influences on climate and aerosols included in the models)

Climate is expected to continue to change in the future (increasing realism of simulations increases confidence; important uncertainties remain but are taken into account in the range of model projections)

There are still many uncertainties (estimates of future emissions, biogeochemical cycling, assessment of variability & detection studies).[69]

69 Intergovernmental Panel on Climate Change. Climate Change 1995: IPCC Second Assessment Report. 1995

2.3.2.3 Third Assessment Report

The Third Assessment Report (TAR) consists of four reports:

- **Working Group I:** The Scientific Basis
- **Working Group II:** Impacts, Adaptation and Vulnerability
- **Working Group III:** Mitigation
- Synthesis Report

The Synthesis Report

An increasing body of observations gives a collective picture of a warming world and other changes in the climate system (The global average surface temperature has increased over the 20th century by about 0.6 °C; Temperatures have risen during the past four decades in the lowest 8 kilometres of the atmosphere; Snow cover and ice extent have decreased). Emissions of greenhouse gases and aerosols due to human activities continue to alter the atmosphere in ways that are expected to affect the climate. Confidence in the ability of models to project future climate has increased. However, complex physically based climate models are required to provide detailed estimates of feedback and of regional features. Such models cannot yet simulate all aspects of climate and there are particular associated uncertainties, however these are so far considered as the best estimates. There is new and stronger evidence that most of the warming observed over the past 50 years is attributable to human activities. Human influences will continue to change atmospheric composition throughout the 21st century Global average temperature and sea level are projected to rise under all IPCC Special Report on Emissions Scenarios. The TAR estimate for the climate sensitivity is 1.5 to 4.5 °C and the average surface temperature is projected to increase by 1.4 to 5.8 °C over the period 1990 to 2100, and the sea level is projected to rise by 0.1 to 0.9 meters over the same period. The wide range in predictions is based on scenarios that assume different levels of future CO_2 emissions. Each scenario then has a range of possible outcomes associated with it. IPCC uses the best available predictions and their reports are under strong scientific scrutiny. The IPCC concedes that there is a need for better models and better scientific understanding of some climate phenomena, as well as the uncertainties involved. Critics assert that the data is insufficient to determine the real importance of greenhouse gases in

climate change. Sensitivity of climate to greenhouse gases may be overestimated or underestimated because of flaws in the models and because the importance of some external factors may be estimated wrongly. The predictions are based on scenarios, and the IPCC did not assign any probability to the scenarios used.[70]

2.3.2.4 Forth Assessment Report

IPCC Fourth Assessment Report (AR4): Climate Change 2007

The key conclusions of the Summary for Policymakers (SPM) were that: Warming of the climate system is unequivocal. Most of the observed increase global average temperatures since the mid-20th century is very likely due to increasing anthropogenic greenhouse gases (CO_2 and CH_4 and N_2O emissions). Anthropogenic warming and sea level rise could continue for centuries due to the timescales associated with climate processes and feedbacks.

In such a scenario, global temperatures could rise by between 1.1 and 6.4°C during the 21st century and sea levels will probably rise by 18 to 59 cm. There is a confidence level >90% that there will be more frequent warm spells, heat waves and heavy rainfall. There is a confidence level >66% that there will be an increase in droughts, tropical cyclones and extreme high tides. Both past and future anthropogenic carbon dioxide emissions will continue to contribute to warming and sea level rise for more than a millennium **(IPCC, 2007).**

70 IPCC TAR SYR (2001), Watson, R. T.; and the Core Writing Team, ed., Climate Change 2001: Synthesis Report, Contribution of Working Groups I, II, and III to the Third Assessment Report of the Intergovernmental Panel on Climate Change, Cambridge University Press, ISBN 0-521-80770-0 (pb: 0-521-01507-3).

2.3.2.5 Fifth Assessment Report

IPCC Fifth Assessment Report (AR5): Climate Change 2013

The report has three parts from various working groups.

- Working Group I: Climate Change, The Scientific Basis
- Working Group II: Climate Change, Impacts, Adaptation and Vulnerability
- Working Group III: Climate Change Mitigation

The AR5 introduces scenarios for future climate projections. This is called the Representative Concentration Pathways (RCPs). They include the RCP2.6, RCP4.5, RCP6.0 and RCP8.5.

These pathways are scenarios which explore the possibility of GHG emissions producing an effective warming of 2.6, 4.5, 6.0 and 8.5 W/m^2 and the associated respective future changes in the climate system.[71]

2.3.3 Sendai Framework

The **Sendai Framework** for Disaster Risk Reduction 2015-2030 **(Sendai Framework)** is the first major agreement of the post-2015 development agenda, with seven targets and four priorities for action. It was endorsed by the UN General Assembly following the 2015 Third UN World Conference on Disaster Risk Reduction (WCDRR).

71 IPCC, 2014: Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.

The Sendai Framework is a voluntary, non-binding agreement which recognizes that the State has the primary role to reduce disaster risk but that responsibility should be shared with other stakeholders including local government, the private sector and other stakeholders.[72, 73]
It aims for the substantial reduction of disaster risk and losses in lives, livelihoods and health and in the economic, physical, social, cultural and environmental assets of persons, businesses, communities and countries.

The Seven Global Targets

(a) Substantially reduce global disaster mortality by 2030, aiming to lower average per 100,000 global mortality rates in the decade 2020–2030 compared to the period 2005–2015.

(b) Substantially reduce the number of affected people globally by 2030, aiming to lower average global figure per 100,000 in the decade 2020–2030 compared to the period 2005–2015.

(c) Reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030.

(d) Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030.

(e) Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020.

(f) Substantially enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation of this Framework by 2030.

72 5. Aitsi-Selmi, A., Egawa, S., Sasaki, H., Wannous, C. and Murray, V., 2015. The Sendai framework for disaster risk reduction: Renewing the global commitment to people's resilience, health, and well-being. International Journal of Disaster Risk Science, 6(2), pp.164-176.

73 Pearson, L. and Pelling, M., 2015. The UN Sendai framework for disaster risk reduction 2015–2030: Negotiation process and prospects for science and practice. Journal of Extreme Events, 2(01), p.1571001.

(g) Substantially increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments to the people by 2030.

The Four Priorities for Action

Priority 1. Understanding disaster risk

Disaster risk management should be based on an understanding of disaster risk in all its dimensions of vulnerability, capacity, exposure of persons and assets, hazard characteristics and the environment. Such knowledge can be used for risk assessment, prevention, mitigation, preparedness and response.

Priority 2. Strengthening disaster risk governance to manage disaster risk

Disaster risk governance at the national, regional and global levels is very important for prevention, mitigation, preparedness, response, recovery, and rehabilitation. It fosters collaboration and partnership.

Priority 3. Investing in disaster risk reduction for resilience. Public and private investment in disaster risk prevention and reduction through structural and non-structural measures are essential to enhance the economic, social, health and cultural resilience of persons, communities, countries and their assets, as well as the environment.

Priority 4. Enhancing disaster preparedness for effective response and to "Build Back Better" in recovery, rehabilitation and reconstruction

The growth of disaster risk means there is a need to strengthen disaster preparedness for response, take action in anticipation of events, and ensure capacities are in place for effective response and recovery at all levels. The recovery, rehabilitation and reconstruction phase is a critical opportunity to build back better, including through integrating disaster risk reduction into development measures.

Implementation guides for the Sendai Framework

The Sendai Framework for Disaster Risk Reduction charts the global course over the next 15 years. During the consultations and negotiations that led to its finalization, strong calls were made to develop practical guidance to support implementation, ensure engagement and ownership of action by all stakeholders, and strengthen accountability in disaster risk reduction. Paragraph 48 (c) of the Sendai Framework calls upon "the United Nations Office for Disaster Risk Reduction (UNISDR), in particular, to support the implementation, follow-up and review of this framework through generating evidence-based and practical guidance for implementation in close collaboration with States, and through mobilization of experts; reinforcing a culture of prevention in relevant stakeholders". In order to support the process, a number of targeted Sendai Framework implementation guides shall be developed.[74, 75]

2.3.4 Warsaw International Mechanism (WIM) For Loss and Damage

Functions of the Loss and Damage Mechanism

The Loss and Damage Mechanism fulfils the role under the Convention of promoting implementation of approaches to address loss and damage associated with the adverse effects of climate change, pursuant to decision 3/CP.18, in a comprehensive, integrated and coherent manner by undertaking, inter alia, the following functions:

74 5. Aitsi-Selmi, A., Egawa, S., Sasaki, H., Wannous, C. and Murray, V., 2015. The Sendai framework for disaster risk reduction: Renewing the global commitment to people's resilience, health, and well-being. International Journal of Disaster Risk Science, 6(2), pp.164-176.

75 Zia, A. and Wagner, C.H., 2015. Mainstreaming early warning systems in development and planning processes: Multilevel implementation of Sendai framework in Indus and Sahel. International Journal of Disaster Risk Science, 6(2), pp.189-199.

1. **Enhancing knowledge and understanding of comprehensive risk management approaches to address loss and damage associated with the adverse effects of climate change, including slow onset impacts, by facilitating and promoting:**

– Action to address gaps in the understanding of and expertise in approaches to address loss and damage associated with the adverse effects of climate change, including, inter alia, the areas outlined in decision 3/CP.18, paragraph 7(a);

– Collection, sharing, management and use of relevant data and information, including gender-disaggregated data;

– Provision of overviews of best practices, challenges, experiences and lessons learned in undertaking approaches to address loss and damage.

2. **Strengthening dialogue, coordination, coherence and synergies among relevant stakeholders by:**

– Providing leadership and coordination and, where appropriate, oversight under the Convention, on the assessment and implementation of approaches to address loss and damage associated with the impacts of climate change from extreme events and slow onset events associated with the adverse effects of climate change;

– Fostering dialogue, coordination, coherence and synergies among all relevant stakeholders, institutions, bodies, processes and initiatives outside the Convention, with a view to promoting cooperation and collaboration across relevant work and activities at all levels.

3. **Enhancing action and support, including finance, technology and capacity-building, to address loss and damage associated with the adverse effects of climate change, so as to enable countries to undertake actions pursuant to decision 3/CP.18, paragraph 6, including by:**

– Providing technical support and guidance on approaches to address loss and damage associated with climate change impacts, including extreme events and slow onset events;

– Providing information and recommendations for consideration by the Conference of the Parties when providing guidance relevant to reducing the risks of loss and damage and, where necessary, addressing loss and damage, including to the operating entities of the financial mechanism of the Convention, as appropriate;

– Facilitating the mobilization and securing of expertise, and enhancement of support, including finance, technology and capacity-building, to strengthen existing approaches and, where necessary, facilitate the development and implementation of additional approaches to address loss and damage associated with climate change impacts, including extreme weather events and slow onset events.

In exercising the above functions, the Loss and Damage Mechanism will, inter alia:

– Facilitate support of actions to address loss and damage;

– Improve coordination of the relevant work of existing bodies under the Convention;

– Convene meetings of relevant experts and stakeholders;

– Promote the development of, and compile, analyse, synthesize and review information;

– Provide technical guidance and support;

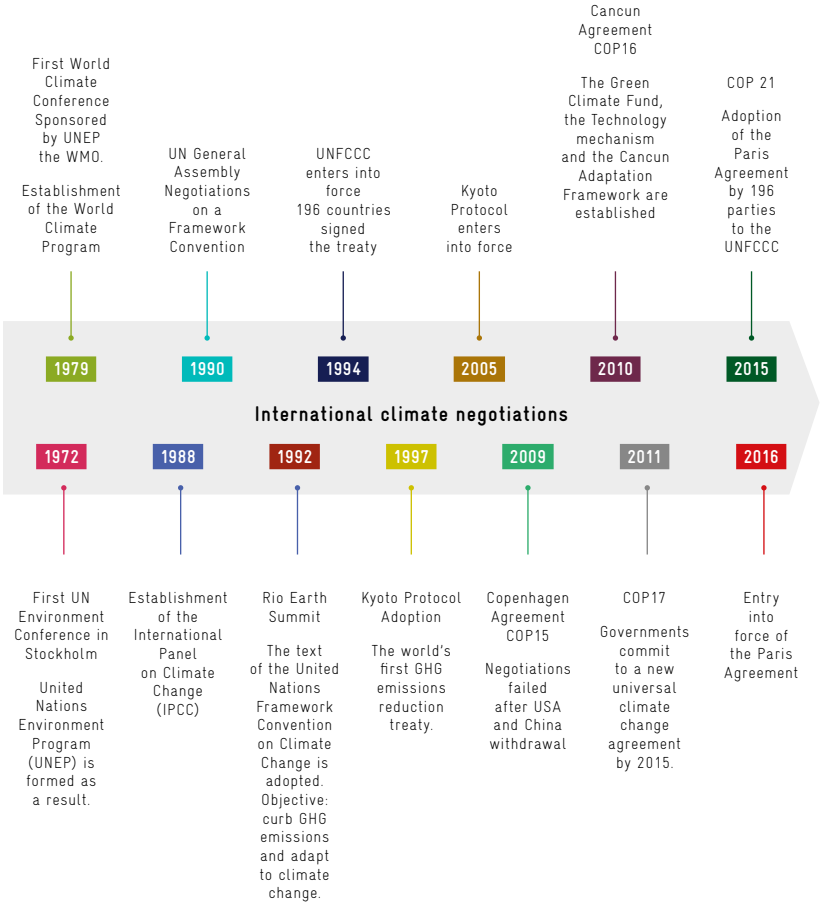
– Make recommendations, as appropriate, on how to enhance engagement, actions and coherence under and outside the Convention, including on how to mobilize resources and expertise at different levels.[76, 77]

76 Stabinsky, D. & Hoffmaister, J. (2015). Establishing institutional arrangements on loss and damage under the UNFCCC: the Warsaw International Mechanism for Loss and Damage. International Journal of Global Warming, Vol. 8, Issue 2. Print ISSN: 1758-2083. https://doi.org/10.1504/IJGW.2015.071967

77 Dilley, M. & Grasso, V. (2016). Disaster reduction, loss and damage data, and the post-2015 international policy agenda. Environmental Science & Policy, Vol 61, July. pp. 74-76

2.3.5 Other Protocols And Agreements And Timeline

Figure 2.1: A summary of Climate Protocols and Agreements.



1979 – The first World Climate Conference takes place.

1988 – The intergovernmental Panel on Climate Change (IPCC) is set up.

1990 – The IPCC and the second World Climate Conference call for a global treaty on climate change. The United Nations General Assembly negotiations on a framework convention begin.

1991 – First meeting of the Intergovernmental Negotiation Committee takes place.

1992 – At the Earth Summit in Rio, the UNFCCC is opened for signature along with its sister Rio conventions, the UN convention on Biological Diversity and the UN convention to Combat Desertification.

1994 – The UNFCCC enters into force.

1995 – The first Conference of the Parties (COP 1) takes place in Berlin.

1996 – The UNFCCC secretariat is set up to support actions under the Convention.

1997 – The Kyoto Protocol is formally adopted in December at the COP3

2001 – The Marrakesh Accords are adopted at COP7, detailing the rules for implementation of the Kyoto Protocol, setting up new funding and planning instruments for adaptation, and establishing a technology transfer framework.

2005 – Entry into force of the Kyoto Protocol. The first Meeting of the Parties to the Kyoto Protocol (MOP 1) takes place in Montreal. In accordance with Kyoto Protocol requirements, Parties launched negotiations on the next phase of the KP under the Ad-Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (AWG-KP). What was to become the Nairobi Work Programme on Adaptation (it would receive its name in 2006 one year later) is accepted and agreed on.

2007 – The IPCC's Fourth Assessment Report is released. Climate science entered into popular consciousness. At COP 13, Parties agreed on the Bali Road Map, which charted the way towards a post-2012 outcome in two work streams: the AWG-KP, and another under the Convention, known as the Ad-Hoc Working Group on Long-Term Cooperative Action Under the Convention.

2009 – Copenhagen Accord drafted at COP 15 in Copenhagen. Countries later submitted emission reductions pledges or mitigation action pledges, all non-binding.

2010 – Cancun Agreements drafted and largely accepted by the COP, at the COP 16. Through the Agreements, countries made their emission reduction pledges official, in what was the largest collective effort the world had ever seen to reduce emission in a mutually accountable way.

2011 – The Durban Platform for Enhanced Action drafted and accepted by the COP at COP 17. In Durban, governments clearly recognized the need to draw up the blueprint for a fresh universal, legal agreement to deal with climate change beyond 2020, where all will play their part to the best of their ability and all will be able to reap the benefits of success together.

2012 – The Doha Amendment to the Kyoto Protocol is adopted by the CMP at CMP8. The amendment includes: new commitments for Annex I Parties to the Kyoto Protocol who agreed to take on commitments in a second commitment period from 1 January 2013 to 31 December 2020; a revised list of greenhouse gases to be reported on by Parties in the second commitment period; and amendments to several articles of the Kyoto Protocol pertaining to the first commitment period and which needed to be updated for the second commitment period.

2013 – Key decisions adopted at COP19/CMP9 include decisions on further advancing the Durban Platform, the Green Climate Fund and Long-Term Finance, the Warsaw Framework for REDD plus and the Warsaw International Mechanism for Loss and Damage.

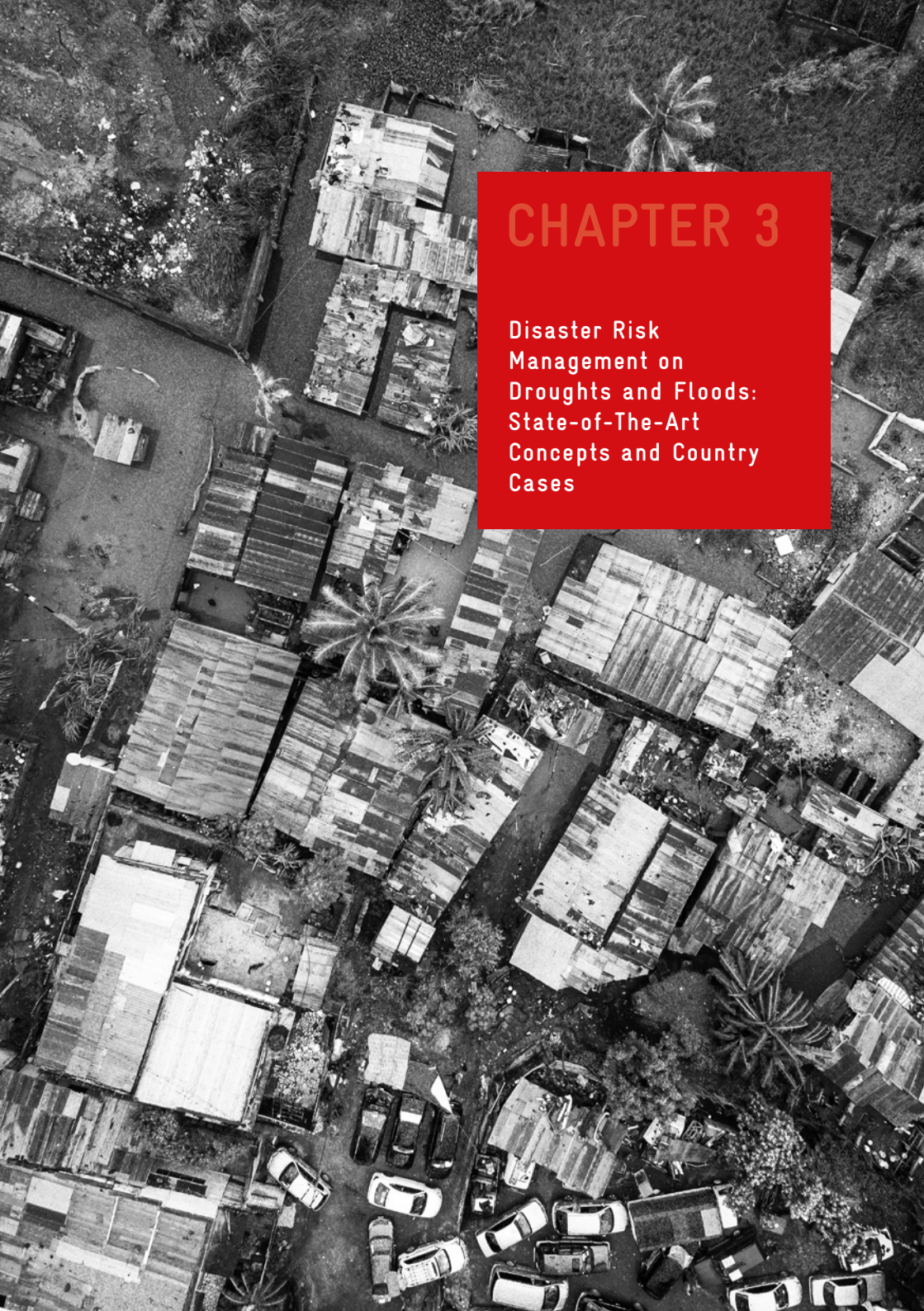
2014 – COP20 was held in December in Lima, Peru.

2015 – COP21 or CMP11 was held in Paris, France in December.

Source: UNFCCC

2.3.6 Summary

Climate change is real and its impact are right before our eyes.
These international bodies have contributed immensely to the management of the impact of climate change and its associated variabilities.
The policy documents and amendment have been very helpful to the international community, both developed and developing countries have benefited from these conventions.



CHAPTER 3

Disaster Risk Management on Droughts and Floods: State-of-The-Art Concepts and Country Cases

3.1 BACKGROUND

Managing disasters is one of the greatest challenges faced by developing countries like Ghana. The challenges are further exacerbated by the progressing climate change and the ever-growing Ghanaian population. Climate change for instance, is likely to change the nature of many types of hazards, their frequencies, intensities, magnitudes and duration as well as the vulnerability of communities to disasters (IPCC 5th Assessment Report). Even though emergency disaster relief subsidies have been a priority for Ghana governments, the rising costs of relief items demands a policy shift from the subsidies towards a long term self-reliance. A multi-disciplinary understanding of Disaster Risk Management (DRM) is, therefore, key in this regard. Understanding and improving DRM especially within the context of climate change is an important step towards ensuring the safety of the Ghanaian populace and property. Following this background, this module introduces a discussion on some concepts and terminologies used in the field of DRM. It further presents the disaster risk profile of Ghana with emphasis on droughts and floods. The module concludes with discussion on Disaster Resilience Capacity (DRC), Disaster Risk Mapping as well as Disaster Risk Management Initiatives and Insurance strategies
that will bring about a safer Ghana.

3.2 OBJECTIVES

The main objective of this module is to provide trainees a better understanding and management of disasters that shape the natural and built environments of Ghana. Specific objectives are that trainees will be able to:

1) Understand commonly used key concepts pertaining to DRM
2) Understand the disaster risk profile of Ghana
3) Learn about the most frequent disasters and their associated burden
4) Understand Disaster Resilience Capacity (DRC) and Disaster Risk Mapping
5) Understand Disaster Risk Management Initiatives and Insurance

3.3 OVERVIEW OF KEY CONCEPTS PERTAINING TO DISASTER RISK MANAGEMENT

3.3.1 Disaster

A disaster is a progressive or sudden, widespread or localized, natural or human-caused calamitous event that exceeds the capacity of the affected area to respond to it in a way as to save lives, preserve property, and to maintain the social, ecological, economic, and political stability of the affected region.[78, 79, 80] van Zyl[81] defines a disaster as an event that causes: death, injury or disease; damage to property, infrastructure or the environment; a disruption of the life of the affected community; and where the magnitude of the event exceeds the ability of the affected to cope with its effects using only their own resources.[82]

It is worth noting that the localized or widespread event itself is not the disaster but rather the effects of the event such as a serious disruption to the functioning of a community involving widespread human, material, economic or environmental losses and impacts, which exceed the ability of the affected community to cope using their own resources.
Moreover, the severity of the impact of a disaster depends on the resilience of the affected population and infrastructure or their ability to recover.[83]
All disasters are not the same and neither are their effects on individuals or communities the same. They are, therefore, classified into two main groups: as Natural and Technological.

78 Pearce, L. (2000). An Integrated Approach For Community Hazard, Impact, Risk and Vulnerability Analysis: HIRV. University of British Columbia Doctoral Dissertation.
79 National Science and Technology Council (2005). Grand Challenges for Disaster Reduction – A Report of the Subcommittee on Disaster Reduction. Washington, DC: National Science and Technology Council (NSTC), Executive Office of the President.
80 Burton, I., Kates, R and White, G. (1993). The Environment as Hazard. Second Edition. NY: Guilford Press.
81 van Zyl, K. (2006). A study on a Disaster Risk Management Plan for the South African Agricultural Sector. A report submitted to Agri SA, TAU SA, NAFU SA and Total SA.
82 Ntajal, J., Lamptey, B. L., Mahamadou, I. B., Nyarko, B. K. Flood disaster risk mapping in the Lower Mono River Basin in Togo, West Africa. International Journal of Disaster Risk Reduction 23 (2017) 93–103.
83 Bankoff, G., Frerks, G., Hilhorst, D., (2003). Mapping Vulnerability: Disasters, Development and People. ISBN 1-85383-964-7.

Natural disasters are events caused by the natural forces of the earth resulting in great damage to property including economic damage and possibly loss of life.[84]

Natural disasters are further sub-divided into:

1) **Geological:** Events originating from the solid earth.
Examples include earthquake, volcano, and mass movement (dry).

2) **Meteorological:** Events caused by short-lived/small to mesoscale atmospheric processes (in the spectrum from minutes to days).
Examples include extreme temperatures, Storm.

3) **Hydrological:** Events caused by deviations in the normal water cycle and/or overflow of bodies of water caused by wind set-up.
Example: Floods, wave action, mass movement (wet).

4) **Climatological:** Events caused by long-lived/meso to macro scale processes (in the spectrum from intra-seasonal to multi-decadal climate variability).
E*xamples: Droughts, Wildfire, Extreme Temperature.*

5) **Biological:** Disaster caused by the exposure of living organisms to germs and toxic substances.
Examples: Disease Epidemics, Insect Infestation, Animal Stampede.

6) **Extra-terrestrial:** Events originating from space.
Examples: Impact crater, space weather.

84 Alexander, D. (1993). Natural Disasters. NY: Chapman and Hall.

Figure 3.1 Example pictures of natural disaster activities in Ghana.[85]

Accra Flooding disaster in 2015.

The 1939 earthquake disaster in Ghana

Kintampo Waterfalls disaster in 2017.

Adaklu landslide in volta region in 2017.

85 Sources from top left to bottom right:
Adapted from https://laboneexpress.com/2015/06/why-the-accra-floods-occur-reasons-from-scientific-studies/. Accessed 11 June 2019.
Adapted from https://www.myjoyonline.com/news/2018/december-10th/trust-god-build-well-minister-advises-potential-victims-of-earth-tremors.php. Accessed 11 June 2019.
Adapted from http://citifmonline.com/2017/06/kintampo-waterfalls-to-reopen-on-sept-1-minister/. Accessed 11 June 2019.
Adapted from https://www.graphic.com.gh/news/general-news/nadmo-awaits-advice-on-adaklu-mountains-landslide-in-volta-region.html. Accessed 11 June 2019.

Technological Disasters on the other hand are events caused by a malfunction of a technological structure and/or some human error in controlling or handling the technology.[86] According to Lindsey,[87] all types of disasters are challenging, but technological disasters tend to be more difficult with the reason that:

They are sudden, unexpected, and unpredictable. Thus, their threats cannot be anticipated. People are often responsible. For instance, victims of technological disasters tend to feel anger towards people responsible for the accidents which could have been prevented. Technological disasters can create disputes within communities which can result in conflicts and breakdown the community.
It may take a longer time to recover since community members tend to concentrate on litigation and blame, and less on clean-up and recovery.[88]
Media coverage of a technological disaster can be constant adding to already heightened stress levels.[89]
Technological disasters are man-made in the sense that there is an identifiable cause characteristic and their impact on communities can often be more detrimental.[90] They include environmental degradation, pollution and accidents as detailed below:

1) **Industrial accidents:** e.g. Explosion, Chemical spill, Oil spill, Radiation, Gas Leakage

2) **Transport Accidents:** e.g. Air, Rail, Road, Water

3) **Miscellaneous:** e.g. Fire, Explosion, Collapse, Others

86 Goldsteen, R. and Schorr, J. K. (1982). The long-term impact of a man-made disaster: An examination of a small town in the aftermath of the Three Mile Island Nuclear Reactor Accident. Disasters, 6: 50–59.
87 Lindsey, A. B., Donovan, M., Smith, S., Radunovich, H. and Gutter, M. (2017). Impact of Technological Disasters. FCS9265 Document available at http://edis.ifas.ufl.edu.
88 Picou, S., Marshall, B., & Gill, D. (2004). Disaster, litigation, and the corrosive community. Social Forces, 82(4): 1497–1526.
89 Morris, J.G., Grattan, L.M., Mayer, B.M., and Blackburn, J.K. (2013). Psychological responses and resilience of people can communities impacted by the Deepwater Horizon oil spill. Transactions of the American clinical and climatological association, 124: 199–201.
90 Lindsey, A. B., Donovan, M., Smith, S., Radunovich, H. and Gutter, M. (2017). Impact of Technological Disasters. FCS9265 Document available at http://edis.ifas.ufl.edu.

Figure 3.2 Example pictures of technological disasters in Ghana.[91]

Kwame Nkrumah Circle gas explosion (Twin disaster) in 2015

Tamale-Kintampo Metro Mass bus accident in 2016.

Kumasi Central Market fire disaster in 2017

Melcom disaster in 2012.

91 Sources from top left to bottom right: http://www.myjoyonline.com; http://www.myjoyonline.com; http://www.myjoyonline.com; http://www.citifmonline.com.

Table 3.1 Differences between natural and technological disasters.[92]

Natural Disasters	Technological Disasters
Are an expected aspect of the physical environment	Are created by human error and use of hazardous materials
Are considered uncontrollable	Are considered controllable
Humans are not held responsible	Humans are perceived responsible
Onset often allows warning/evacuation	Occur rapidly and without warning
Reluctance to evacuate until the threat looms	The population will evacuate without instructions to do so
The event and its effect on people and the environment are generally visible	The event and its effects on people and the environment are generally invisible
Recovery is generally visible (e.g., removal of debris)	Recovery is generally invisible (e.g., removal of radiation cannot be seen)
Individuals can personally observe the effects of a natural disaster	Because the effects are often invisible, individuals are more dependent on authority figures and/or the media for facts
Private individuals, public agencies, and corporations become involved in the response	Corporations and governments respond while private citizens are relegated to roles as victims
Authority figures are seen as helpful	Authority figures are seen as evasive and unresponsive
Individuals tend to personalize event	Individuals tend to depersonalize event
Mitigation focuses on human adjustment to potential events or to hazardous areas	Mitigation tends to focus on the technical process
Response/relief efforts more common than mitigation because of perceived lack of control over the event	Because of perceived control, mitigation is more common than response/relief
Familiarity develops due to experience	Familiarity is lacking due to lack of experience

92 Pearce, L. (2000). An Integrated Approach For Community Hazard, Impact, Risk and Vulnerability Analysis: HIRV. University of British Columbia Doctoral Dissertation.

3.3.2 Hazard

A hazard is an event or physical condition that has the **potential to cause** fatalities, injuries, property damage, infrastructure damage, agricultural loss, damage to the environment, interruption of business, or other types of harm or loss.[93] Hazards arise from the interaction between social, technological and natural systems, posing threats to people, their environment and the things they value.[94, 95] Hazards can vary in terms of socio-economic status, political structure, culture, race and gender.[96] A hazard differs from a disaster in that the former is the potential for disaster to occur.[97] That is, while a hazard is the potential that at a given period in a given area, an extreme, potentially damaging natural or human-induced phenomena may occur, the impact of the occurring phenomena leads to a disaster. Like disasters, hazards are grouped into five classes as follows:[98]

- **Natural hazards:** Include atmospheric, geologic and hydrologic hazards like storms, earthquakes and floods, as well as the spread of infectious diseases.
- **Technological hazards:** Major accidents, industrial failures, hazardous materials threats to human life and unsafe public buildings.
- **Context hazards:** International air pollution, deforestation, desertification, loss of natural resources, intensive urbanisation, climate change.
- **Super hazards:** Catastrophic earth changes, impact from near earth objects.
- **New-concern threats.** The on-going spread of technology and urbanisation, together with growing social diversity and political tension creating opportunities for international violence and terrorism.

93 FEMA. Multi Hazard Identification and Assessment. Washington, D.C.: FEMA. 1997.
94 Burton, I., Kates, R and White, G. (1993). The Environment as Hazard. Second Edition. NY: Guilford Press.
95 Cutter, S. L. (2001). The Changing Nature of Risks and Hazards. Chapter 1, in American Hazards capes: The Regionalization of Hazards and Disasters. Washington, DC: Joseph Henry Press.
96 Mitchell, J. T. and Cutter, S. L. (1997). Global Change and Environmental Hazards: Is the World Becoming More Disastrous? Washington, DC: Association of American Geographers.
97 Pearce, L. (2000). An Integrated Approach For Community Hazard, Impact, Risk and Vulnerability Analysis: HIRV. University of British Columbia Doctoral Dissertation.
98 van Zyl, K. (2006). A study on a Disaster Risk Management Plan for the South African Agricultural Sector. A report submitted to Agri SA, TAU SA, NAFU SA and Total SA.

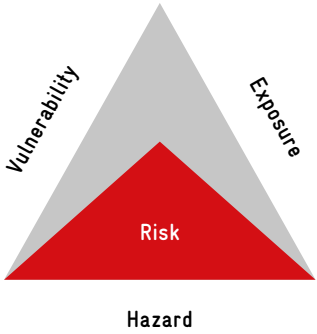
3.3.3 Risk

Risk is the probability of a hazard occurring and creating a disaster.[99, 100] It is the actual exposure of something of human value to a hazard and is often regarded as the combination of probability and loss.[101] The distinction between risk and hazard is that the latter is the potential threat of an event to humans and their welfare while the former is the probability of a specific hazard occurring. For instance, an earthquake hazard may exist in an uninhabited region but an earthquake risk can only occur in an area where people and their possessions exist. Thus, people and what they value are the essential point of reference for all risk assessment as well as for all disasters.[102]

Disaster risk is widely recognized as the consequence of the interaction between a hazard, vulnerability and level of exposed.[103] This interaction is depicted in → Figure 3.3 and well elaborated in → Figure 3.4.

99 National Science and Technology Council (2005). Grand Challenges for Disaster Reduction – A Report of the Subcommittee on Disaster Reduction. Washington, DC: National Science and Technology Council (NSTC), Executive Office of the President.
100 Smith, K. (1996). Environmental Hazards: Assessing Risk and Reducing Disaster. 2nd ed. London and New York: Routledge.
101 Blanchard, B.W. (2007). Emergency Management-Related Terms & Definitions Guide. Assessed in April 2018 at https://www.hsdl.org/?abstract&did=745967.
102 Smith, K. (1996). Environmental Hazards: Assessing Risk and Reducing Disaster. 2nd ed. London and New York: Routledge.
103 Cutter, S. L. (2001). The Changing Nature of Risks and Hazards. Chapter 1, in American Hazards capes: The Regionalization of Hazards and Disasters. Washington, DC: Joseph Henry Press.

Figure 3.3 Risk Triangle



Risk = Hazard x Vulnerability x Exposure

Understanding disaster risk is not only to consider the hazard, the exposure and vulnerability but also the capacity/preparedness of the society to protect itself from disasters and the loss expected. This is expressed mathematically according to Smith[104] as:

$$\text{Risk} = \frac{\text{(Hazard (probability) X Loss (Expected))}}{\text{(Preparedness (Loss Mitigation))}}$$

The characteristics of risk according to the UNISDR Global Assessment Report[105] are that risk is:

1) **Forward looking:** the likelihood of loss of life, destruction and damage in a given period of time.

2) **Dynamic:** it can increase or decrease according to our ability to reduce vulnerability.

3) **Invisible:** it is comprised of not only the threat of high-impact events, but also the frequent, low-impact events that are often hidden.

104 Smith, K. (1996). Environmental Hazards: Assessing Risk and Reducing Disaster. 2nd ed. London and New York: Routledge.

105 UNISDR, (2009). Global Assessment Report on Disaster Risk Reduction. Accessed April 2018 at www.preventionweb.net/english/hyogo/gar/report/index.php?

4) **Unevenly distributed around the earth:** hazards affect different areas, but the pattern of disaster risk reflects the social construction of exposure and vulnerability in different countries.

5) **Emergent and complex:** many processes, including climate change and globalized economic development, are creating new, interconnected risks.

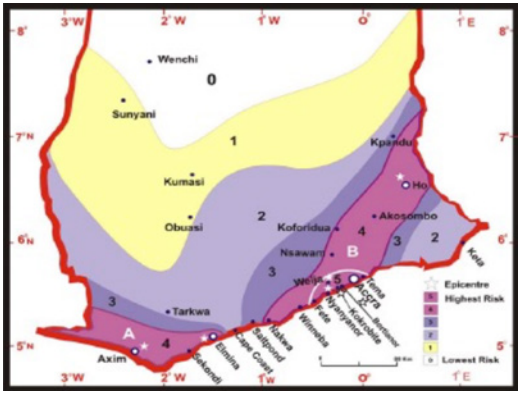
Figure 3.4 Conceptual framework of disaster risk.[106]

106 Ntajal, J., Lamptey, B. L., Mahamadou, I. B., Nyarko, B. K. Flood disaster risk mapping in the Lower Mono River Basin in Togo, West Africa. International Journal of Disaster Risk Reduction 23 (2017) 93–103.

3.4 DISASTER PROFILE OF GHANA

The historical overview of disasters in Ghana can be traced back to colonial times. These disasters have taken various forms such as flooding, drought, earthquake, gas explosion, landslides among others. Based on these disasters, NADMO has put in place various hazard maps, education and training programs, emergency preparedness and response plans. The first ever earthquake event in Ghana was in 1615 followed by three major ones in 1862, 1906 and 1939.[107] Apart from the 1939 earthquake event, there have been a number of earth tremors at various magnitudes. The southernmost of parts of the country is found to be more prone to earthquake activities with epicentres located at Ho, Weija, Nyanyanor, Elmina and Axim than other parts of the country (→ See Figure 3.5). Besides the earth tremors, there has been a number of landslide activities mostly triggered by rainfall. These landslides activities are detailed in → Table 3.2.

Figure 3.5: Map of earthquake epicentres in Ghana for the period from 1615 to 2003.[108]

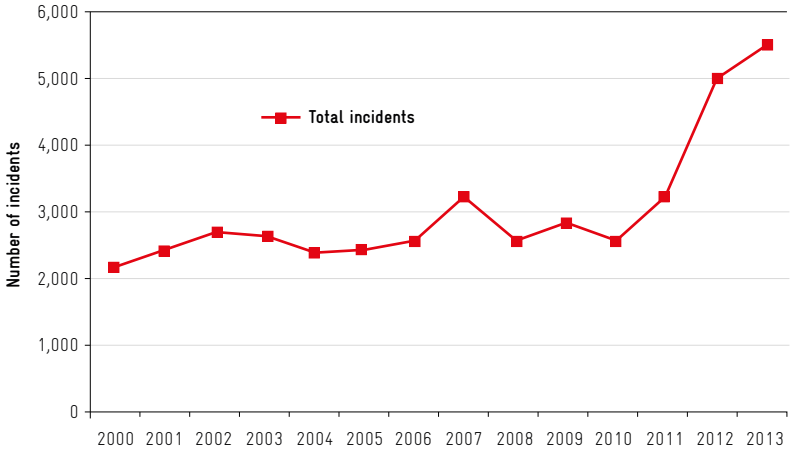


107 Amponsah, P. E. (2004). Seismic Activity in Ghana: Past, Present and Future. Annals of Geophysics, 47(2/3), 539-543.

108 Kutu, J.M. (2013). Seismic and tectonic correspondence of major earthquake regions in southern Ghana with Mid-Atlantic transform-fracture zones. International Journal of Geosciences, Vol. 4. Pp. 1326-1332.

Another disaster of concern is domestic, industrial, institutional, commercial and vehicular fires. These fires come with devastating consequences including property damage, loss of lives and properties. For instance, in 2013 about 11,000 Ghanaians were affected by fire and explosion which cost about $7 million in terms of relief items.[109] Figure 3.6 illustrates the pattern of fire incidents that have occurred in Ghana from 2000 to 2013. Within this period, fire incidences were almost same from 2000 to 2010 but showed a sharp rise afterwards. Other notable disasters are droughts, floods and epidemics (→ see Figure 3.7). Among them, flood is number two after epidemics with regards to loss of lives. According to Asumadu-Sarkodie et al.,[110] floods have killed about 415 people out of 3.86 million people since 1968-2015 (excluding 3rd June, 2015 floods that was coupled with an explosion at the Goil filling station in Accra which claimed over 152 lives in Accra). Economical loss caused by flood in Ghana in 2015 alone was about US$ 108,200,000.[111] In Table 3.3 the historical evidence of flood activities and their impacts are presented.

Figure 3.6 Patterns of annual fire incidents in Ghana.[112]



109 Tulashie, S.K., Addai, E. K., Annan, J. S., (2016). Exposure assessment, a preventive process in managing workplace safety and health, challenges in Ghana. Saf Sci, 84:210-215

110 Asumadu-Sarkodie, S., Owusu, P. A., and Rufangura, P. (2015). Impact analysis of flood in Accra, Ghana. Advances in Applied Science Research, 6(9):53-78.

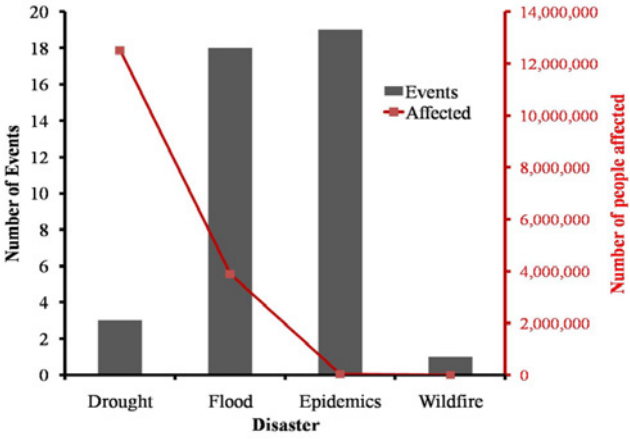
111 EM-DAT: The OFDA/CRED International Disaster Database, www.emdat.be - Université catholique de Louvain.

112 Addai, E. K., Tulashie, S. K., Annan, J-S., Yeboah, I. (2016). Trend of Fire Outbreaks in Ghana and Ways to Prevent These Incidents. Safety and Health at Work, 7(4):284-292

Table 3.2 Historical overview of landslide disasters in Ghana.

Location	Year	Trigger	Effect/ Casualty
Kam, a village near Pitiku Junction, ER	1972/ March 5, 2005	Rainfall	The entire Afram Plains District and part of Kwahu South District were cut off from the rest of the country
Peduase-Water Works road, ER	June 20, 2010	Rainfall	Part of the stretch of the Pantang-Mamfe dual carriageway was blocked
Adukrom-Yensi, ER	October 6, 2010	Rainfall	Region killed three persons and destroyed many properties
Wassa Asikuma and Wassa Nkran in the Prestea/ Huni Valley District, WR	October 25, 2012	Rainfall	Twenty acres of cocoa farms belonging to sixty farmers were destroyed
Adaklu Helekpe, VR		Rock split with water gushing out	More than 70 acres of farmlands submerged
Aboabo near Koforidua	October 10, 2016	Rainfall	Carried heavy rocks from the mountains through farms to the community with a distance of about 6 kilometres

Figure 3.7 Common disasters in Ghana from 1900 to 2015 [113]



113 Asumadu-Sarkodie, S., Owusu, P. A., and Rufangura, P. (2015). Impact analysis of flood in Accra, Ghana. Advances in Applied Science Research, 6(9):53-78.

Table 3.3 Historical flood profiles in Ghana from 1968 to 2017.

Date	Area/Location	Impact description
4th July 1968	Accra Metropolis	Recorded 5inches of rainfall
29th June 1971	Sekondi-Takoradi	Several hundreds of dwelling houses collapsed, rendering thousands of people homeless.
5th July, 1995	Accra Metropolis	Affected commuters, vehicles and the Achimota VRA substation, resulting in power cuts.
13th June 1997	Accra Metropolis	Floods halted many institutions in the various parts of the city.
1999	Upper West, Upper East, the Northern regions and the northern parts of Brong Ahafo and Volta regions.	Three hundred thousand (300,000) people were affected. It cost GH¢280,000 to manage the disaster.
28th June 2001	Accra Metropolis	Submerged portions of the city, affecting many houses and structures within Madina, Achimota, Dzorwulu, Avenor, Santa Maria, and Adabraka Official Town.
2007	Upper West, Upper East and Northern Regions	307,127 people were affected by floods
5th May, 22nd June, 2010	Accra Metropolis	Death toll of 35.
24th June 2010	Agona Swedru municipality	NADMO) registered at least 3,000 flood victims in Agona, Swedru
14th October 2010	Country wide	Flood displaced 161,000 people across the country during a torrential rains and the opening of the Bagre Dam in Burkina Faso

18th October 2010	Central Gonja District	55 communities were submerged by flood following the overflow of the Volta Lake
2nd Nov 2010	Kwahu East, Kwahu, South, and Kwahu North districts in the Eastern Region	2,800 people in 120 villages and towns along the Volta Lake were rendered homeless by floods and destroying 850 buildings, farms, markets, and roads.
24th Feb. 2011	Accra Metropolis	A downpour wreaked extensive havoc on properties in most parts of Accra and some of its surrounding communities.
20th July, 2011	Atiwa District in the Eastern Region	10 hours of torrential rain left 105 farmers stranded on farms for 3 days while it drown five (5) persons at Akyem Osoroase Krobomu
1st Nov 2011	Accra	Affected 43,087 people with 14 deaths
31st May 2013	Accra	heavy rains caused flooding in some parts of Accra
6th June 2014	Accra	10 hour downpour caused flooding in some parts of Accra
3rd June, 2015	Accra	Heavy downpour claimed over 152 lives as a GOIL Fuel Station exploded at the Kwame Nkrumah Circle

3.5 DROUGHT AND FLOODS

3.5.1 Drought

Drought is an extended period of time characterized by a deficiency in a region's water supply as a result of constantly below average precipitation.[114] WMO[115] defined drought as 1) a prolonged absence or marked deficiency of precipitation, 2) a period of abnormally dry weather sufficiently prolonged for the lack of precipitation to cause a serious hydrological imbalance. It is a condition of climatic dryness that is severe enough to reduce soil moisture and water levels below the minimum necessary for sustaining plant, animal, and economic systems.[116] Rainfall variability in Ghana, driven by global and regional climatic processes has accounted for major droughts in 1982/83, 1992, 1997, 2001, 2007 and 2015/2016. This eventually resulted in adverse socio-economic impacts on the nation at large.

3.5.1.1 Types of Droughts

1. **Meteorological Drought:** Defined on the basis of the degree of dryness, in comparison to a normal or average amount, and the duration of the dry period. Definitions of meteorological drought must be region-specific, since the atmospheric conditions that result in deficiencies of precipitation are highly region-specific.

114 Guha-Sapir D, Vos F, Below R, with Ponserre S. Annual Disaster Statistical Review 2011: The Numbers and Trends. Brussels: CRED; 2012.
115 World Meteorological Organization (WMO) (1992). International Meteorological Vocabulary (Second Edition). Geneva, Switzerland: World Meteorological Organization.
116 van Zyl, K. (2006). A study on a Disaster Risk Management Plan for the South African Agricultural Sector. A report submitted to Agri SA, TAU SA, NAFU SA and Total SA.

2. **Hydrological Drought:** refers to a persistently low discharge and/or volume of water in streams and reservoirs, lasting months or years. Hydrological droughts are usually related to meteorological droughts, and their recurrence interval varies accordingly. Changes in land use and land degradation can affect the magnitude and frequency of hydrological droughts.

3. **Agricultural Drought:** links various characteristics of meteorological drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evapotranspiration, soil-water deficits, reduced groundwater or reservoir levels, and so on.

4. **Socio-economic Drought:** occurs when the demand for an economic good exceeds the supply as a result of a weather-related shortfall in water supply. It differs from the other types of drought in that its occurrence depends on the processes of supply and demand. Due to the natural variability of climate, water supply is ample in some years, but insufficient to meet human and environmental needs in other years

3.5.1.2 Causes of Droughts

1. **Natural causes:**

   a) Delayed rain or insufficient rainfall. Drought may occur when monsoon winds which bring rain are delayed causing prolonged dry season.

   b) Global atmospheric processes such El Niño and La Niña causes change in rainfall patterns. El Niño is the abnormal warming of the water surface at the South-eastern part of the Pacific Ocean and is accompanied by high air pressure in the western Pacific and low air pressure in the eastern Pacific. This causes extreme weather like heavy rain which can increase the likelihood of flooding in the Eastern Pacific and droughts in the Western Pacific. La Niña on the other hand usually follows after an El Niño. This time, places along the eastern pacific experience droughts while areas in the western pacific experience heavy rain, which also increase the likelihood of flooding.

2. **Human causes:**

   a) Deforestation: Reduced vegetation cover lowers the rate of transpiration, leading to less water vapour in the atmosphere. Thus, fewer clouds will be formed and less rain will occur, which in turn leads to droughts.

   b) Enhanced greenhouse effect: The increase in greenhouse gases in the atmosphere causes a rise in the Earth's average global temperature, known as global warming. This causes significant changes in the weather conditions such as droughts.

3.5.1.3 Impact of Droughts

1. **Shortage of food and water.** Lack of water makes people and animals die of dehydration and crops destroyed leading to famine.

2. **Damage to environment:** Prolonged drought may cause desertification in arid and semi-arid places. Soils in such areas may also become dry and unable to support vegetation growth.

3. **Forest fires and haze:** Vegetation in the forest becomes very dry catching fire easily. Smoke from such forest fires are far-reaching. Haze from such fires affects the environment and health of people.

4. **Cost:** Becomes extremely expensive for affected areas to take measures against droughts

3.5.2 Floods

There are different research views on the concept of flooding based on the sources, impacts, extent or a combination of different factors. Nyarko[117] indicate that flooding is an inundation of an area by unexpected rise of water by either dam failure or extreme rainfall duration and intensity in which life and properties in the affected area are under risk. Others suggest that floods are an overflow of water that submerges land that is usually dry.[118, 119]

Flood hazards are the most common and destructive of all disasters and are a constant threat to life and property. Flood risk is therefore the combination of the probability of a flood event and of the potential adverse consequences for human health, the environment, cultural heritage and economic activity associated with a flood event.[120]

Figure 3.8 Example pictures of flood type activities in Ghana.[121]

Urban flash floods in Accra.

River floods in Chereponi District, 2016

River Pra flood disaster in 2017

Tidal wave surge in Keta in 2015

117 Nyarko, B. K. (2000). Flood Risk Zoning of Ghana: Accra Experience. International Archives of Photogrammetry and Remote Sensing. Vol. XXXIII, Part B7.
118 Chow, V. T., (1956). Hydrologic Studies of Floods in the United States. International Association of Scientific Hydrology Publication, Vol. 42 pp 134–170.
119 Ward, R., (1978). Floods-A Geographical Perspective. Macmillan Press, London.
120 Ntajal, J., Lamptey, B. L., Mahamadou, I. B., Nyarko, B. K. Flood disaster risk mapping in the Lower Mono River Basin in Togo, West Africa. International Journal of Disaster Risk Reduction 23 (2017) 93–103.
121 Sources from top left to bottom right: https://laboneexpress.com; http://www.pulse.com.gh; http://www.myjoyonline.com; http://www.pulse.com.gh.

The main drivers of floods include climate change and local urban change. Climate change affects storm occurrence and intensity while local urban change alters the urban land surface and water pathways through construction activities and deforestation as well as blockage of drains and diversion of natural water flows. Available literature [122, 123] distinguishes different types of floods as:

- **Flash Floods:** Occurs due to inadequate drainage. Generate quickly with little warning.

- **River/Stream Flooding:** Flooding from streams/rivers whose catchment areas lie almost entirely within built-up areas. Occurs when rivers or stream overflow their banks.

- **Coastal Flooding:** Flooding from the sea, or from a combination of high tides and high river flows from inland. Occurs when large storm or Tsunami causes the sea to surge inland.

122 Abbott, P. L. (2006). Natural Disasters, 5th Edition, McGraw-Hill Companies Inc., New York USA.
123 Smith .K. and R, Ward, (1998). Floods Physical Processes and Human Impacts, John Wiley and Sons Chichester, New York..

3.5.2.1 Causes of floods

1) **Natural causes:**

a) Excessive rainfall: areas that experience tropical monsoon climate have seasons of heavy rainfall. The excess rainwater is unable to seep into the ground and rivers may overflow their banks because they can no longer contain them, leading to flooding

b) Storm surges: Tropical storms can cause strong winds to blow over the ocean and create gigantic waves, which crashes onto the coast to flood the land.

c) Melting snow: In places that experience cool temperate climate, the melting of snow in spring releases large amounts of water into rivers and sometimes causes the river to overflow their banks and flood the area.

d) Global atmospheric processes: El Niño and La Niña can cause heavy rains, which can increase the likelihood of flooding in different parts of the world at different times.

2) **Human Causes:**

a) Deforestation: Removal of vegetation causes an increase in surface runoff, which increases the volume of water flowing into rivers. Deposition of materials on the riverbeds such as mud and soil causes the rivers to become shallower. As a result, flooding occurs.

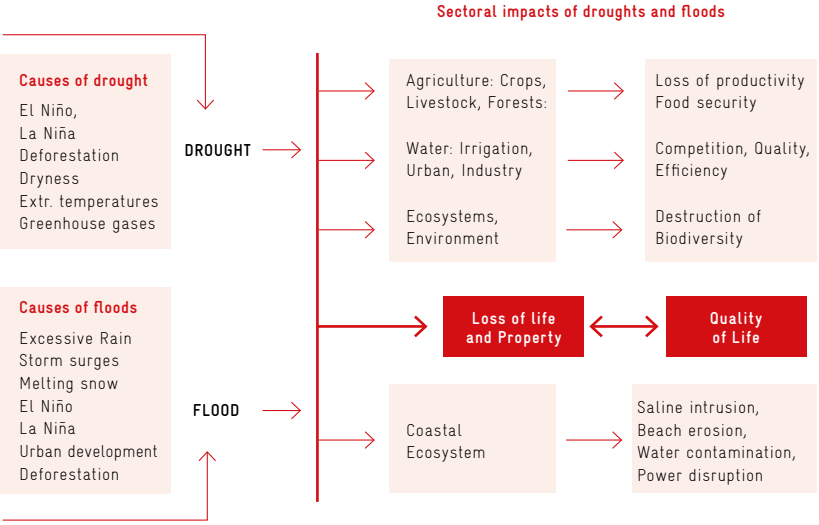
b) Urban development: Due to the growing population, more land is cleared for the development of housing and industries to meet the needs of the urban population. Tarred roads, concrete pavements and clearing of vegetation reduce the infiltration of water and increase the amount of surface runoff flowing into rivers, which can cause floods.

c) **Enhanced emission of Greenhouse Gases:** Global warming will cause climatic changes such as higher rainfall in wetter regions, which may in turn result in higher incidences of floods and severe storms. The increase in the average global temperatures also causes the reduction of ice-cover in the Polar Regions, resulting in rising sea levels. This increases the possibilities of coastal flooding.

3.5.2.2 Impact of floods

1) Environmental hazards
2) Pollute water, thereby spreading diseases quickly
3) Causes severe damage to coastal ecology
4) Causes damage to roads, bridges, and railroads and telephone lines
5) Submerges villages and towns and damaging properties
6) High economic cost
7) Loss of lives

Figure 3.9: Pictorial summary of the causes of drought and floods and their sectoral impacts



3.6 DISASTER RESILIENCE CAPACITY

Resilience is the capacity of a system, community or society to resist or to change in order that it may obtain an acceptable level in functioning and structure.[124] Disaster Resilience Capacity is therefore the measure of the capacity of a system to absorb and recover from the impact of a hazardous event.[125] This is determined by the degree to which the social system is capable of organizing itself, and the ability to increase its capacity for learning and adaptation, including the capacity to recover from a disaster.[126] These involves aiding communities and countries to be adequately prepared to withstand and rapidly recover from a disaster such as drought, flood, earthquake, landslide, etc. → Figure 3.10 shows a scheme of community resilience through emergency preparedness and community well-being promotion.

Figure 3.10 Schematic of community resilience.[127]

124 Blanchard, B.W. (2007). Emergency Management-Related Terms & Definitions Guide. Assessed in April 2018 at https://www.hsdl.org/?abstract&did=745967.
125 van Zyl, K. (2006). A study on a Disaster Risk Management Plan for the South African Agricultural Sector. A report submitted to Agri SA, TAU SA, NAFU SA and Total SA.
126 United Nations International Strategy for Disaster Reduction (UNISDR), 2002. Living With Risk: A Global Review of Disaster Reduction Initiatives. Geneva: UNISDR.
127 Adapted from http://www.laresilience.org/. Accessed 11 June 2019.

Resilience is common in areas where disasters are a normal part of life and group coping strategies are important. Such communities:

1) Learn from past disasters in order to be better prepared for the next response.

2) Determine necessities for damage reduction and proper assets or resource usage.

3) Take opportunities to strengthen the various sectors.

To build Resilience capacity to disaster, our energies ought to be tailored toward improving resilience to disasters at all levels, including individual, community, regional and national. The homes, workplaces, schools and places of worship are the first avenues for educating ourselves on disaster risk reduction. Most communities always try to adapt to changing situations by initially using indigenous knowledge to cope with the situation. Hence, these resilience approaches must be grounded in local knowledge and communicated broadly, for greatest impact, so that everyone protects him or herself from such disasters. Beyond this, the coping strategies need to be reinforced through training. Summarily, the building blocks to disaster resilience capacity include (see also → Figure 3.11):

1) **Education:** sharing of experience within and among communities, with disaster risk managers also listening and learning from the grassroots in order to build upon tried and tested examples of risk reduction by local experience.

1) **Engagement:** using innovative ways and means to reach all people in the community. This encompasses both primitive and modern technologies and methods which helps the community to respond quicker to disasters.

1) **Partnership:** bridging organizations and people to improve coping abilities to disasters.

1) **Self Sufficiency:** Neighbour-neighbour ties, skills sharing, and support helps communities thrive.

Figure 3.11 Building Blocks for disaster resilience.[128]

3.7 DISASTER RISK MAPPING

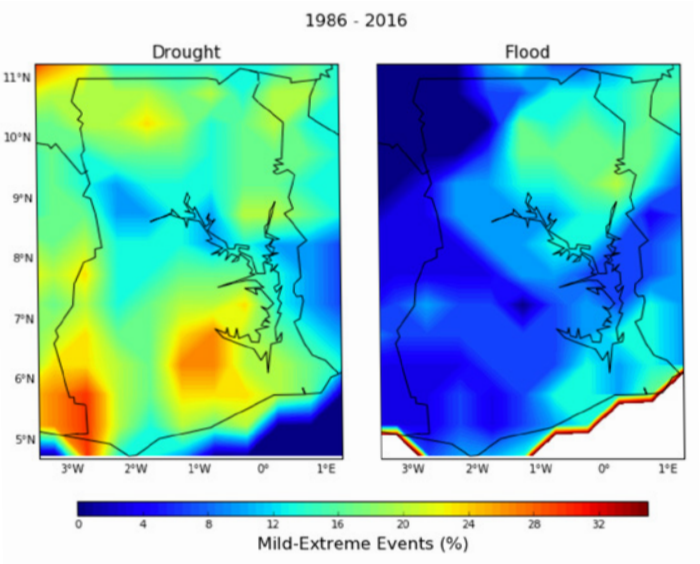
Disaster Risk Mapping is the process of establishing the spatial and temporal extent of risk combining information on probability and consequences. Risk mapping requires combining maps of hazards, exposure, and vulnerability functions. Disaster Risk Mapping is important in that it:

- Delineates disaster-prone areas
- Helps to develop region-specific, rapid response strategies
- Is useful for provision of early warning systems
- Allows effective pre-disaster monitoring and combating

128 Adapted from https://www.rand.org/pubs/infographics/IG119.html. Accessed 11 June 2019

→ Figure 3.12 show an example mapping of areas in Ghana prone to droughts and floods induced by climate change. These maps display the magnitude and nature of the droughts and floods for parts of the country at risk. Climate observations from the Climate Research Unit (CRU), especially monthly rainfall for the last 30 years were used to map-out these climate-induced droughts and flood prone areas in the country. The Standardized Precipitation Index (SPI) was used to characterize the magnitudes of the droughts and floods between mild-to-extreme cases (expressed in percentages) relative to their climatological means.

Figure 3.12 Drought and flood Risk map for Ghana.



Drought events (see left panel) are more eminent in most parts southern Ghana compared to the north. These events are more pronounced in parts of the Western, Eastern and Ashanti regions. In the northern half of the country, the upper west region is more prone to drought events compared to others areas. The north-eastern corner and South-eastern coast of the country are rather at risk of flood events (see right panel). These maps are important because they provide knowledge and understanding of flood and drought disaster risk for better decision making and evidence based environmental planning in Ghana.

The capital city of Ghana, Accra, is noted for its frequent flood disasters (see → Table 3.3). In → Figure 3.13, the climate-induced annual flood profile for the city is presented. Despite the spatial analysis showing south-eastern coast of Ghana to be relatively more flood-prone (see → Figure 3.12, right panel), it can be observed that flood-disasters in the last 7 years (2010–2016) are not entirely climate-driven except the 2010 and 2011 flood disasters. This suggests that other factors such as improper city planning, building in waterways and lifestyle seem to compound these disasters.

Figure 3.13 Climate-induced annual flood profile for Accra.

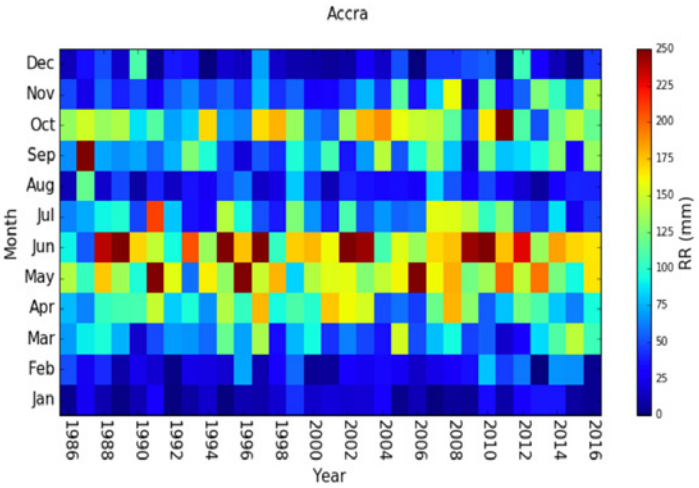
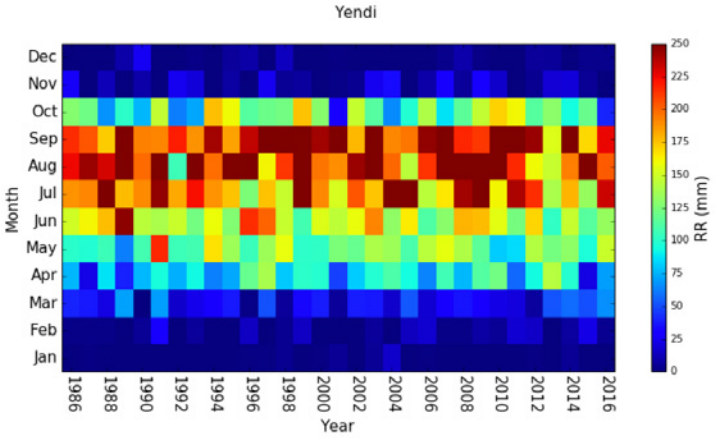


Figure 3.14 Climate-induced flood annual flood profile for Yendi.



Besides Accra, Northern Ghana has also been in the news concerning flood disasters (see → Table 3.3). For instance, in October 2010, 55 communities in the central Gonja District were submerged by flood following the overflow of the Volta Lake. This is not surprising because the Northern Region, for past three decades, has recorded larger rainfall magnitudes between July and early October within its uni-modal rainy season (see → Figure 3.14). Unlike the case of Accra, it can be observed (see → Figure 3.14) that almost all the flood disasters in Northern Ghana such as that of the 1999, 2007 and 2010 are climate induced.

3.8 DISASTER RISK MANAGEMENT

Disaster risk management is a continuous and integrated multi-sectoral, multi-disciplinary process of planning and implementation of measures aimed at preventing or reducing the risk of disasters, mitigating the severity or consequences of disasters, emergency preparedness, rapid and effective response to disasters, and post-disaster recovery and rehabilitation.[129] DRM process ensures that a household, community, city or any area will be able to anticipate, resist or recover from the losses sustained from a hazard or other threat, without external assistance.[130]

3.8.1 Elements of DRM

The elements of DRM encompass factors that are intended to strengthen the management of risks and the consequences of disasters or to reduce losses.[131] In → Figure 3.15, a general framework of disaster risk management process is shown.

129 van Zyl, K. (2006). A study on a Disaster Risk Management Plan for the South African Agricultural Sector. A report submitted to Agri SA, TAU SA, NAFU SA and Total SA.

130 Blanchard, B.W. (2007). Emergency Management-Related Terms & Definitions Guide. Assessed in April 2018 at https://www.hsdl.org/?abstract&did=745967.

131 van Zyl, K. (2006). A study on a Disaster Risk Management Plan for the South African Agricultural Sector. A report submitted to Agri SA, TAU SA, NAFU SA and Total SA.

Figure 3.15 A general framework of activities for disaster risk management process.[132]

132 Adapted from http://www.climate-insurance.org/projects/advancing-climate-risk-insurance-acri/. Accessed 11 June 2019.

The framework embodies core elements of:

1) **Risk Assessment:** According to Kates and Kasperson,[133] risk assessment is contained in three distinct steps as follows: 1) the identification of hazards likely to result in disasters 2) the estimation of the risks of such events; and 3) the evaluation of the social and economic consequences of the derived risk.

2) **Prevention or reduction of risks:** This includes measures designed to provide permanent protection or reduce the intensity of a hazardous event so it does not become a disaster e.g. reforesting an unstable slope to prevent landslides.

3) **Mitigation:** This includes measures taken well in advance of a hazard alert to minimise the severity or consequences of disasters and the vulnerability of communities and households to a known or expected threat e.g. protecting deep wells in cholera-prone areas, crop diversification to drought tolerant varieties.

4) **Preparedness for emergencies:** Advance measures taken to predict, respond to, and manage a hazard event. Measures that prepare people to react appropriately before, during and after an emergency, e.g. dissemination of early warning information on approaching cyclone, or intensified health education before the rainy season.

5) **Response or Relief to disasters:** Measures taken to alleviate immediate hardship and meet basic needs for shelter, water, sanitation, health care as well as search, rescue and protection of those affected.

6) **Recovery or rehabilitation (post disasters):** Process undertaken by a disaster-affected community to fully restore itself to its pre-disaster level of functioning and which enables it to become even more disaster-resistant (e.g. planting/harvest of drought resistant crops, storm-proofing essential community buildings, schools and clinics).

133 Kates, R. & Kasperson, J. (1983). Comparative Risk Analysis of Technical Hazards (A Review). Proceedings of the National Academy of Sciences of the United States of America. Vol 20, issue 22.

DRM processes must therefore be open since it has to factor in benefits, costs of control, and any statutory or socially approved requirements needed to manage the risk. This requires communicating and consulting with the public-at-large, either directly or through appropriate representation as well as with specialists.[134, 135]

3.8.2 DRM Initiatives

Disaster risk management initiatives are essential in order to contain the related stress of climate-induced disasters. There are numerous facilities that challenge countries to adapt initiatives to manage disaster risks. A common facility is the African Risk Capacity (ARC). The core mandate of ARC is to help member states improve their capacities for planning, preparation and response to disasters. The ARC Strategic Framework outlines challenges of various governments across Africa in designing and implementing robust disaster risk management procedures. The Strategic Framework addresses regional, national and continental issues, while drawing from the successes of its on-going work. ARC provides insurance products to member states. For instance, Member States like Mauritania, Niger and Senegal have benefited from these financing products following a significant drought in the Sahel in early 2015.

That notwithstanding, countries need to also individually build appropriate early warning tools and ensure on-going seasonal monitoring in order to respond to disasters. For better and rapid response to disasters, there is the need for partnership between the major disaster risk management stakeholders (e.g. NADMO, GMet, EPA, GSSD, etc.). More importantly, there is the need to take both individual and community-based precautionary measures to ward off the massive negative impacts of disasters as suggested in → Table 3.4.

134 Blanchard, B.W. (2007). Emergency Management-Related Terms & Definitions Guide. Assessed in April 2018 at https://www.hsdl.org/?abstract&did=745967.
135 Britton, N. R. (1998). Safeguarding New Zealand's Future: Emergency Management's Role in Shaping the Nation. Foresight, pp. 1-12.

Table 3.4 Individual and community-based precautionary measures against massive disaster impacts

Individual Measures	Community / National Measures
Acquiring Personal Emergency kits	Assessing and addressing community vulnerabilities
Emergency plans	Developing community partnerships
Individual education and training	Community training, education, and engagement
Individual/household-oriented messages	Being observant
Being observant	Community preparedness networks/social connections
Personal Insurance Measures	A reserved short code to allow communities, in the wake of disasters, to rapidly contact disaster risk managers.

In the case of Individual- and Community-Based Management Measures, there is the need for

1) **Knowledge development:** research in disaster reduction and disaster control.

2) **Precautionary disaster risk reduction measures:** Land management; development of land use concepts; mass movement monitoring; engineering surveys and monitoring of structural measures (e.g. dams, dikes).

3) **Early warning:** Technologies and techniques for early warning systems, e.g. data acquisition and analysis; software development; cartographic visualization; disaster modelling; usage of geodetic control networks.

4) **Emergency management:** use of virtual 3D models of towns, buildings and landscape for an easier location in case of a disaster (evacuation and emergency planning); supply of digital maps for emergency planning, mobile mapping.

5) **Recovery/Reconstruction:** documentation of damages (by laser scanning or tachometry); damage assessment of the destroyed or harmed buildings and public facilities; cadastral reconstruction.

3.8.3 Disaster Risk Insurance

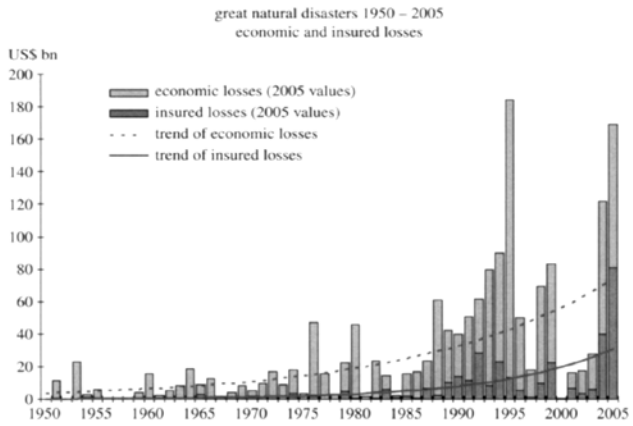
Insurance is a form of risk management tool used to hedge against the risk of a contingent uncertain loss. The goal of disaster risk insurance is to spread the financial impact of disaster events by providing the means of covering the insurer from risks and protection from unforeseen losses. It also involves pooling funds from many insured entities (exposures) to pay for the losses that some may incur. The insured entities are therefore protected from risk for a fee, with the fee being dependent on the frequency and severity of the occurring event.

Insurance coverage is broadly grouped into two main types, namely life insurance and general insurance. Life insurance pays out a certain amount of money to the insured or their specified beneficiaries upon a certain event such as retirement, illness or death of the individual who is insured. General insurance on the other hand protects the insurer against losses and damages of material goods or property loss such as burnt house. Disasters in general results in loses of properties and possibly life. For instance, the scale of loss from natural disasters in low-income countries often exceeds the resources of internal and external sources of relief funding. The outrageous scale of losses requires a form of risk management strategy such as insurance.

There are standard conditions for insurability of an entity. These conditions according to Rejda[136] are that:

- There must be a large number of exposure units;
- The loss must be accidental and unintentional;
- The loss must be determinable and measurable;
- The loss should not be catastrophic;
- The chance of loss must be calculable;
- The premium must be economically feasible

Figure 3.16: Economic and insured losses from great natural disasters from 1950 to 2005.[137]



136 Rejda, G. E. (1995). Principles of Risk Management and Insurance. 5th Edition. New York: HarperCollins.
137 Smolka, A. (2006). Natural Disasters and the Challenge of Extreme Events: Risk Management from an Insurance Perspective. Philosophical Transactions: Mathematical, Physical and Engineering Sciences. Vol. 364, No. 1845.

Despite the high social and economic impact of disasters, a catastrophic risk of an entity does not meet all the standard conditions of insurability as outlined by Rejda.[138] Petak[139] points out that while insurance is designed to reduce the public burden of individual loss, it is less useful for managing the economic impact and correlated losses of a catastrophic event. This is attributed to the fact that natural disasters for instance cause highly correlated losses which are essentially uninsurable. For instance, → Figure 3.16 displays a global economic and insured loss from great natural disasters from 1950 to 2005. It can be observed that both economic and insured losses have been on the rise since 1950 but with a dramatic increase of both economic insurance losses over the last two decades. This dramatic rise in losses makes it difficult to insure against natural disasters.

However, an alternative for regular insurance of catastrophic events following the rising losses is the catastrophe bond.[140] These bonds help to hedge against the upper limits of catastrophic loss. They offer the opportunity to transfer the risk of low-probability, high-loss events to the capital market where there is greater capacity to absorb disaster losses. Catastrophe bonds should therefore be incorporated as a risk-transfer mechanism for developing countries.[141] Catastrophe bonds with subsidized premiums could provide a source of contingent capital to help in times of catastrophic events.

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CHAPTER 4

Communication and Media Work on Disaster Resilience

This unit outlines the methods for effective communication of disasters and the role of the media in disaster resilience.

LEARNING OBJECTIVES

By the end of this unit, participants must be able to:

- Know the modes/methods of communicating disaster issues
- Know the impacts of disaster communication on citizen's behaviour
- Identify best communication practices
- Identify the role of the media in disaster communication

4.1 INTRODUCTION

Among various aspects of Disaster Management, communication is one of the most critical requirement. The word „communicate" implies conveying of thoughts, ideas, warnings, instructions, orders, knowledge and information. In the context of disaster management, fail-safe communication is vital during a wide range of actions, from the significant phase of „preparedness" to impart knowledge and information (mass education and public awareness), to warning of an impending threat of disaster, to mobilizing various resources and information for authorities, and for conducting disaster management in general.

Figure 4.1: Communication as an effective information dissemination approach

Communication during and immediately after a **disaster** situation is an **important** component of response and recovery. It connects affected people, families, and communities with first responders, support systems, and other family members. Communication during the pre-event phase should promote awareness, preparedness, and access to helpful information.

4.2 COMPONENTS OF COMMUNICATION

- **Channels** – Channels are mediums/means through which the communication is being passed/disseminated. We have different channels through which we communicate both in the urban and rural areas (settings) which helps to proffer a better result of what is being sent.

- **Noise** – in the context of communication, noise is anything that interferes with or distorts our ability to send or receive messages. Noise could be semantic factors such as uncertainty about what another person's words are supposed to mean.

- **Context** – Communication always takes place in some context or setting. Every communication starts from somewhere, there must be a setting that helps to make it real and natural and even acceptable.

- **Feedback** – In communication, whenever we interact, communicate with one or more persons, we receive information in return. In communication we have positive feedback and negative feedback. Positive feedback enhances whatever behaviour is in progress. It encourages us to continue with our information/attitude. In contrast, negative feedback extinguishes a behaviour; it serves as corrective rather than a reinforcing behaviour.

- **Effect** – As people communicate, they are changed in some way by the interaction, which in turn influences what follows. These effects could be as a result of exchange of influence. Communication always has some effect on you and on the person or people with whom you are interacting. An effect can be emotional, physical, cognitive or any combination of the three. Without all of these elements communication can never be complete and its effectiveness is diminished.

4.3 SIGNIFICANCE OF COMMUNICATION IN DISASTER PREPAREDNESS AND MITIGATION

Whenever we talk of „Disaster", we invariably imply the following distinct phases:

1) Preventive and preparedness measures for ensuring minimum adverse effects

2) Follow up actions in the event of occurrence of a Disaster, to handle the „Aftermath" and make all efforts to mitigate - i.e. to minimize to reduce eventual losses/damage to life and property.

Unless we have „Communication" at its best in all the required forms we will not be in a position to deal with the above phases to our entire satisfaction. In the aftermath of a disaster, time counts and efficient communication at all levels decides the success of all efforts. It is therefore essential to critically examine the role – and need – of communication. The discussion that follows will critically examine the same in the above mentioned phases.

4.4 COMMUNICATION DURING THE PHASE OF PREVENTIVE MEASURES

An in-depth study of all probable causes of disasters likely to occur in the area is to be made, identifying all likely sources of disaster.

– **Preparedness:** This is the most important phase. The state of Preparedness is to be reached to maximum efficiency. In this phase, all resources, their types and strength, are worked out, identified and are placed „on call" for the moment they are needed. This phase requires high degree of dedication and cooperation of all resources. Resources imply police, firemen, medical personnel, transporters, volunteers and above all a sound communication system.

4.5 COMMUNICATION DURING THE FOLLOW-UP PHASE

– **Immediately after a Disaster Occurs:** Communication, in all its forms, plays a most vital role in this phase. The prime requirement of this phase is to convey facts without creating any panic. Also, the time element is of utmost importance. Even a minor delay caused due to incomplete or incorrect communications will exacerbate the problem. Notification of the occurrence of a disaster is to be given, following an agreed-upon priority, to government officials, the affected population, and news media. This becomes effective only when there are „Check Lists" at all levels and personnel are trained to act strictly yet timely according to their respective check lists. In the absence of check lists, chaos will prevail, disrupting the smooth and adequate responses.

4.6 BEST COMMUNICATION PRACTICES

Communication of disaster is very relevant due to their erratic nature. They can occur abruptly (floods) or gradually (droughts). To properly communicate them, rigorous studies must first be performed to understand and predict their variability. The results of these studies need to be communicated with major stakeholders for resilience to be effective. The message must be well packaged to be understandable and of use to the stakeholders. The following should be considered:

– **Localize the message:** Natural disasters are unpredictable and their impacts are felt in the lives of individuals and communities. Therefore, the message on disaster management, risks and resilience and associated issues must be packaged into a relevant local context. The message should reflect on issues that are actually being experienced by the stakeholders and therefore are important in their local communities.

– **Reality of the message:** Stakeholders should be made to understand from the communication the reality of the effects of disasters and the possibility of implementing adaptation and mitigation policies rather than doing nothing.

- **Target audience:** The level of exposure and understanding of disasters are different for all level of stakeholders. Hence the same approach of a message package is not always the best way of communicating the issues. The message should be restructured towards different audience for maximum impact to be achieved.

- **Avoid criticism:** It is not a good idea to mobilize support for disaster management by criticizing the behaviour of people usually considered to be normal in their homes and lives. Instead, encourage behaviours to reduce the threat of disasters which are positive and desirable to them. For instance, a gradual and strong education on the need of resettling to areas which are less prone to disasters.

4.7 EFFECTIVE COMMUNICATION

If the goal of communication is achieved, then it simply signifies that there is an effective communication between the sender and the receiver at the same level. In disaster resilience, some goals for effective communication are to:

- **Create awareness and shift attitudes among stakeholders:** Create awareness and understanding on the occurrence of disasters, their history, trend analysis, management, risks and resilience.

- **Facilitate mobilization for support:** Mobilizing people to act on the issues of disaster management could be achieved through effective communication. This can be conducted through rigorous outreach programmes to community groups, leaders and other stakeholders.

- **Enhance understanding of disaster resilience and risk management issues:** Communication creates the opportunity to educate most stakeholders about disasters through the acquisition of vital information and statistics as well as demystifying any misconceptions and misunderstandings.

- **Involve all social categories to disaster management:** Within a community, some members may be more vulnerable than others depending on their economic status, level of education, physical location, asset holdings, gender and age. Disaster communication must hence incorporate/involve the vulnerability status of the particular community and its individuals.

- **Improve policy response regarding disaster risk management:** In Ghana, efforts to adopt policies to aid in disaster risk management are inadequate. Through communication at all levels, local authorities and the government could be motivated or even pressurized to respond to the need for policies to support in disaster risk management at the community level.

- **Motivate people to act before disasters:** People are motivated to do more when they become aware through communication that their efforts to adapt to natural disasters will go a long way in building disaster resilience.

4.8 WAYS TO ENSURE EFFECTIVE COMMUNICATION

Disaster Management Directory: For day to day interactions on disaster resilience, the telephone is going to be the major medium. Therefore, a group-wise Telephone directory is very necessary to connect to stakeholders at higher levels in the community.

- **Skilled Personnel:** Having obtained costly communication equipment, skilled personnel need to be trained to handle it. Every instrument has to be kept in daily use by scheduled „checking“. The equipment needs to be maintained and always kept in serviceable condition.

- **Vigorous and Regular Training:** It must be an integral activity so as to build and maintain the capacity to effectively respond to disasters. For example, if using non-standard communication technology (e.g. a wireless set), duty personnel must be trained in to operate it in a clear manner to ensure that they can communicate when needed.

– **Sub-Control Rooms/Alternate Control Centres:** In the event of main Control Room being ineffective for any reason, there must be another one to assume charge without interruption in the operations.

Table 4.1: Guide on ensuring effective communication at various phases of disaster events

Risk communication -pre-event, anticipatory	Crisis communication -during event, incident specific	Communication -before events	Communication - during event
Engage in Interactive Processes or Dialogue			
Interactive processes and dialogue among individuals, groups, and institutions help facilitate understanding of risk perceptions	Plan and coordinate with community partners and first responders	Interactive communication strategies can lead to better support for desired outcomes.	Provide opportunities for community members to ask questions of fire personnel
Strive to Understand The Social Context in which the Threat is Situated			
Understanding the social context of risk can help design culturally sensitive messages which can then help effectively frame, present, and discuss risk content for the audience	Listen to the public's concerns to understand the audience	Create opportunities to meaningfully engage in risk management decisions to develop a more comprehensive understanding of values and concerns and the broader social context in which residents are situated	High levels of uncertainty during a fire create greater demand for information tailored to recipient's specific needs (house loss, need to evacuate, etc.)

Provide honest, timely, accurate, and reliable information			
Present risk messages with honesty; account for inherent uncertainties	Distribute accurate, timely, and useful information about the current state of affairs and what is known and not known. Communicate with compassion, concern, and empathy, accepting uncertainty and ambiguity Emphasize honesty, candour, and openness in message delivery	Agency transparency in decision making provides trust in ongoing preparedness processes	Accurate, timely, and reliable information are of particular concern during an event
Working with credible sources, including authority figures when appropriate			
Credibility, similarity, and appropriateness of the message and deliverer can affect acceptance of message; collaborate and coordinate with credible information sources. Leveraging personal relationships that are credible with the public including officials or authority figures if appropriate may engender greater trust among the recipients of the information.	Status of the message deliverer is important. Collaborate and coordinate with credible sources: Authority figures or emergency managers deliver message	Active participation with agency representatives, including proactive, two-way communication and hands-on education opportunities are important Frequency, reliability, and predictability of contact help build trust and credibility	Those with limited agency interactions before and during a fire were more likely to be critical of how the fire was managed

Communicate before and during crisis			
Integrate across pre- and during crisis stages, treat risk communication as a process	Communication between citizens and agencies during each phase of the event cycle can affect outcomes during another phase		

4.9 DELIVERING THE MESSAGE

- **Select the right communication channel to suit target audience:** Different target groups in the community will be most perceptive to different modes of communication presentation. It is imperative to know the target groups in order to select the most effective means of delivering the message.

- **Use credible and effective voice:** People learn through social interaction and by nature some people are talented teachers, trustworthy and trendsetters. Using such people for communication will result in a more effective and readily accepted message by the audience. Credibility of the message is also important because, if a source of information cannot be trusted, then audience believe there could be some hidden motivation.

- **Consistency in delivery:** The message on disasters should be clear and language use and explanations must be very consistent. This will help make the message stick in people's minds.

- **Communications must be sustained:** Raising awareness for action is time consuming because it takes effort and time to change people's attitude. Therefore, there is the need to plan for sufficient time to allow initiatives to work. Successful public awareness is achieved through consistent sustainability over a long period of time.

– **Build good public relations and use of feedback:** Maintaining good relations with stakeholders is very important for creating an environment in which the audience is receptive to the message. Be honest about the issue at hand and desist from twisting the message. Obtaining feedback from the community through their experiences is an important way of evaluating the effectiveness of the message transmitted.

4.10 COMMUNICATION METHODS/MODES

– **Traditional (Face-to-face):** One of the best and most efficient approaches to communication of disaster resilience is by direct engagement with the target audience. It provides opportunity to engage and interact with individuals who in turn could act as ambassadors in the delivery of the message. It also provides an opportunity for in-depth education of those who wish to become more involved.

– **Public information systems:** Almost every community in Ghana now has some form of a public information centre where information of communal importance is kept and announcements are made to the general public. These are also suitable platforms for disseminating disaster issues to the target audience.

– **Printed materials:** Information can be distributed through printed materials such as brochures, fliers, magazines, posters and newsletters. These forms of communication would be most useful in the local communities if they involve comprehensive pictorial narrative of disaster management issues rather than descriptive forms.

– **Radio broadcast:** Radio communication is one of the commonest means to transmitting information to a larger audience. Community radio stations could therefore be used as platforms for delivery of disaster issues. This method is more effective when it involves panel discussions and phone-in interactive sessions by the target audience.

- **Television broadcast:** Television programmes could also be used in highlighting disaster resilience issues to the general public. This is however expensive but policy makers and the central government could be involved to fund education and awareness of the occurrence of natural disasters through television programmes.

- **Lectures/Seminars/Workshops:** The traditional form of imparting knowledge in the classroom setting is to be used when communicating disaster issues to higher level stakeholders. Organized workshop/seminar approach enables the stakeholders to share and contribute to knowledge on disaster management, risks and resilience more effectively than using the lecturing approach.

- **Social Media:** Various platforms are available for the transmission of information on social media platforms such as WhatsApp (most popular among Ghanaians), Twitter, Instagram, Facebook etc. Disaster information can be sent to group pages which are in turn distributed by group members to their individual contacts and other group pages. This cycle is repeated by any individual who receives this information and can reach a large audience. A major disadvantage is that such information needs to be verified for credibility and reliability.

- **School curriculum:** Information on disaster issues can be incorporated in school curricula development to raise awareness and educate the young in the community and how to handle disasters.

4.11 CHALLENGES IN DISASTER RESILIENCE COMMUNICATION

In Ghana, two major challenges are likely to be faced when communicating on disaster resilience.

- **Language:** Language barrier is a major challenge for the effective communication of disaster resilience. Ghana has a diversity of languages among stakeholders and communicators fluent in the local dialects for a particular community must always be recruited before messages can be conveyed, especially in rural and peri-urban areas.

- **Inertia:** This results from the reluctance of people to change from a well-known situation into the unknown. With lack of meaningful incentives to drive the willingness to build resilience, many stakeholders within the local community are left with the choice of adapting. Affected communities are observed to be too attached to their livelihood and assets and hence readily adopt any adaptation plans to build resilience rather than mitigation plans.

4.12 IMPACTS OF DISASTER COMMUNICATION ON CITIZEN'S BEHAVIOUR

When disaster is communicated through various channels, their first response impact on citizen's behaviour is how the information is disseminated by the communities of people rather than commercial and/or government controlled entities. The information helps individuals in different locations, having different occupations to gather and make use of their collective skills and information bases. The response can also help organize action and mobilize people and let them organize themselves, becoming volunteers that can start rescue operations before the responding organizations reach the location affected by the emergency.

The potential availability of real-time information on the location of people (victims) and resources provides important benefits for a first response, and dissemination of solutions to problems faced during a crisis. By using channels such as social media, radios and donation services, citizens were able to provide

equipment, medical aid, and other supplies that were urgently needed by the victims of the disaster, and could urge private organizations to provide disaster relief and help the victims by helping the shipment/transport of aid packages and supplies.

4.13 CREDIBILITY AND RELIABILITY OF DISASTER INFORMATION

The credibility and reliability of the source of disaster information can have profound effect on how users of information view and respond to messages about environmental risks. Key characteristics related to information delivered during a crisis event include crafting honest, trustworthy messages, and leveraging credible sources. Users must be able to evaluate the reliability and credibility of data and information by knowing its source. Information providers as well as the agencies (NADMO/MoFA) should therefore be responsible for the content that is published and disseminated.

During an emergency, timely and transparent production and dissemination of information generates trust and credibility. The source from which crisis information is received will directly affect how credible the information is perceived to be by an individual. The type of social medium for communication also impacts the perceived credibility of the information. Crisis information that comes from traditional media channels, such as printed news, televised news, and official news sources are perceived more credible than social media news.

4.14 WORKING WITH COMMUNICATION MEDIA

Whenever a hazard turns into a disaster of any kind, journalists and relief workers are among the first to arrive on the scene. But they have very different agendas. Journalists have to access and verify real time information, conform to communication ethics and get their story ahead of the competition. In the information age, disaster managers have to balance their own humanitarian priorities with the need to manage information flows and maintain good relations with the media.

4.14.1 The role of communication media during emergencies and disasters

When a disaster strikes, the media perform a social function by providing prompt, first-hand coverage of the situation. Having an alliance with media outlets makes it easier to engage them in time of disasters and emergencies. During this time, they serve as a critical partner to facilitate the transmission of messages that can generate humanitarian assistance, inform public behaviour, and contribute to improving the quality of life in these circumstances. It is known that the media can be instruments of criticism and scrutiny in situations where there have been irregularities, lack of transparency, or irresponsible management of assigned resources and emergency situations. This, in turn, engenders a public demand for accountability of resources received and actions taken. In this context there are two important factors to consider when working with communication media:

– Ensure that the media have access to information on the emergency, its impact on the population, relief operations, and developments along the way. Once messages are based on fact and evidence, the media can assist in managing population response, reducing uncertainty, and focusing attention on the most pressing matters and required public action.

– Build alliances with the media and coordinate initiatives to protect the assets of the public. The media can promote civil support and participation and guide cooperative efforts not only among disaster victims, but among the response teams, groups providing assistance, and donors.

4.14.2 Understanding communication media

The mass media should be viewed as important allies. Their credibility and broad coverage enables messages to be distributed in record time to their audiences both locally and internationally, as necessary. In emergency and disaster situations, the media will both demand and provide information. To strengthen partnerships between the media and disaster sector during an emergency, it is critical to understand the structure of the media, their main characteristics, accessibility, and their advantages and disadvantages before an event.

To ensure a successful relationship, planning, understanding, trust, and credibility are necessary before, during, after the emergency. NADMO and MoFA authorities must plan their communication strategies, integrate communicators into the most senior levels, provide transparent messages, and listen to the public's concerns. Prior approval of communication strategies helps to minimize secondary damage (such as adverse economic or political effects) and leads to greater trust.

4.15 WHAT THE MEDIA WANT

Information that is accurate, timely, transparent, and regularly updated. To know the official position about the facts. To know everything that you know about the emergency. Messages that are consistent, compelling, clear and truthful. Images, numbers and statements from key actors. Resources to help them better understand the emergency. Clarification of rumours to avoid publishing information based on speculation Acknowledgement of and correction of errors, when necessary.

4.16 SOME MAIN AVAILABLE MEDIA CHANNELS

Table 4.2: Popular media outlets and their roles in disaster communication

Role during response phase	Role during recovery phase
Television	
Television images (once properly prepared) vividly demonstrate the situation and the needs of the affected communities. Televised coverage of an event attracts the attention of donors, relief agencies, etc., and gives credit to their response. It is an ideal medium for live transmission. Wherever available, television is the most effective means of public communication.	Television is usually involved during the recovery phase through informational or investigative programs. It can be vital for reporting on the quality of relief operations and in strengthening a culture of transparency and accountability. During this phase, televised debates and panel discussions can highlight analysis of humanitarian assistance operations, and the roles played by and contributions made by donors.
Radio	
It allows communities that have been cut off by a disaster to communicate with relief sector authorities, to inform them on their situation. Programs can be transmitted live. It is the most effective medium for managing the population's emotions and for providing warnings to communities during the first hours following an event. It functions as a community bulletin board where families can contact each other, and provides other services to the community. It is a low-cost way to launch fund-raising campaigns.	Community stations are particularly useful in assisting the population during their recovery. Trained announcers who are usually from the community can broadcast messages educating on disaster resilience. After the recovery phase, stations can continue to air programs about changing behaviours, risk situations, and preventing new emergencies, where possible.

Print Media

They publish key information so that the public knows how to behave (e.g., evacuation plans, how to keep water supplies clean, etc.).	They inform the public about actions taken by certain agencies and public accounting of funds received, and explain how they have been spent.
Useful for publishing action plans and for making appeals for assistance and donations.	Publish testimony and photographs of survivors, challenges they face, and unmet needs, so that the disaster is not forgotten.
Put the needs of the victims on the international agenda, through reports produced by news agencies.	Commemorate the time that has passed since the disaster, for example: "Six months after the earthquake, the aid is nearly exhausted," or "A year after the floods, families start a new life."
Ideal for publishing in-depth interviews that analyse the situation or report on damage and needs assessments.	Can be used to provide information on how individuals can prepare for a disaster or emergency; prevent and/or respond should the event reoccur.
Their graphics communicate the story in itself which complements the written text.	

Computer-based

Immediate information updates on the emergency or disaster.	When special programs or segments are created on the emergency it is easy to include information about the recovery phase. The communication team should be prepared to provide to the newspaper (or other medium) photographs (with credits, description), statements, interviews, etc.
Ideal for publishing photographs.	These media are usually receptive to commemorating the anniversary of an emergency or disaster and are willing to publish news and special reports about the recovery process of the affected communities months or even years after the event.
Multimedia platform allows publication of statements with audio, videos about relief activities, text analysing situation, or life stories.	
Fastest medium for disseminating notes, press releases, news bulletins.	
Journalists working in the affected area can post blogs about their experience and report on progress in relief operations.	
Important: Links can be made to the NADMO/MoFA website.	

4.17 RECOMMENDATIONS FOR WORKING WITH THE MEDIA

- **Anticipate:** Be proactive—do not wait for them to ask for information. Develop a partnership based on trust; show interest and willingness to share information.

- **Minimize ambiguity:** Deliver concise, timely, and clear information. Describe facts rather than processes.

- **Treat them equally:** Do not discriminate because of size, penetration, or ideology; local, national, or international coverage; broadcast, or print.

- **Find common interests:** Generally, journalists are not specialists in disasters. Help them to understand the emergency.

- **Pay attention to their demands:** Address their demands and do not tell them how they should do their work.

- **Monitor coverage:** Providing information is no guarantee that it will be published. Keep track of what is and is not published or broadcast. Also keep track of other related publications/broadcasts which can inform your communication activities as required.

- **Know the decision makers:** In important cases, approach and establish alliances with news editors and directors. They decide the what, how, and when of the news.

4.18 HOW TO REACH THE MEDIA

- **Press releases (Pointers for preparation):** ***What*** exactly is being announced? The key message must be precise and the information provided should be as detailed and complete as possible. ***Why*** did an event take place? Why were the announced decisions made or actions taken? ***Why*** is the agency that is issuing the press release involved in the emergency? ***Who*** is giving the news? If it is the NADMO/MoFA Representative's office, the press release should clearly say so. It should be clear when you are announcing something jointly with the MoFA, a national civil defence entity, or other U.N. agencies. ***Where*** did the disaster occur or where is the predicted danger? ***When*** did it occur or when is the event expected to happen? Name and contact information of a responsible person the media can contact for clarification and expansion. Include a website address that will provide more information.

- **Press conferences (Pointers):** ***What*** message should be delivered and this must be brief and provides detail. It is advisable that each press conference address a specific topic. ***Who*** will host the conference (NADMO/MoFA/ both). Each agency represented must designate a spokesperson before the event. ***Where*** the event should be organized. ***When*** the conference be held. Press conferences are best held early in the day, depending on local customs. They should be held immediately after you learn important news, especially if it is bad news. Indicate clearly the names and positions of the people who will speak during the press conference. Include the address of a website that provides more details.

- **Interviews:** Interviews are another way to reach the media. They provide the opportunity to directly explain, from the perspective of experts, the predicament of the affected population, actions taken by the disaster sector, and the progress made in relief efforts. It is an ideal way to provide more in-depth information on specific or more complicated topics. Interviews also can increase media awareness about their role during an emergency or disaster.

4.19 TIPS FOR GIVING INTERVIEWS

– Find out whether there will be one interviewee or if others have been invited. Choose two or three central messages to focus on during the interview. Think carefully before responding to interviewer questions. Set the tone and control the direction of the interview. State your conclusions at the opening and provide additional information at the end.

– Offer to provide follow-up information if you cannot provide an answer during the interview. Ignore small mistakes that do not affect the information. Tell the journalist about major mistakes, if there are any. Restate the objectives of the organization. Prepare photographs and offer them to the media. Review the published interview and identify areas where improvement is needed.

– Do not speculate or try to respond about something you don't know. Do not give long answers; be brief and concrete. Do not try to impress the journalist with a superior attitude. Do not refuse to respond to a question; or if you do, explain the reasons. Do not speak on behalf of others. Do not lie or try to hide the truth. Never assume that the microphone has been turned off when the interview is over.

4.20 RECOMMENDATIONS FOR THE OFFICIAL SPOKESPERSON

During contact with the media the person who assumes the role of spokesperson for NADMO/MoFA must be prepared to answer many questions. Some are standard and can be anticipated, such as:

– What happened? What type of event was it? Where and when did it happen? What caused it? Why did it happen? How many people are injured, dead, affected, or missing? What has been damaged? Are victims receiving help?

The great demand for information from the media provides a unique opportunity to explain the mechanics of humanitarian assistance, and to give visibility to the operations and practices. Keep this in mind when the media ask the following questions:
What should the affected population do? Where should they go?
What should be donated? To whom should donations be made? Who is in charge of the emergency and what are they doing? What are expected consequences in the short-, medium-, and long-term? What are the sector's plans to help the population? Where can we get more information?

4.21 GUIDELINES FOR SPOKESPERSONS

Be calm, honest, transparent, and open when you communicate. Use a clear and simple message, avoid scientific or technical jargon. Be aware of the audience you want to reach. Distinguish between talking to the media and talking to the affected population. Be sincere when you express your empathy with the affected people. Express confidence, but never arrogance. Modulate your voice and enunciate words.

Discuss what you know, not what you think. Remain calm and in control; do not react defensively. Agree to an interview only when you have a clear message to deliver. Listen to and show respect to those speaking to you. Anticipate questions about the evolution of the crisis and about what is to come. Assume that the microphone is always turned on. Never make "off the record" statements.

4.22 RECOMMENDATIONS FOR MONITORING THE MEDIA

Make a directory of web pages to keep track of media outlets interested in the emergency, and determine whether your institution's messages have had any influence.

Subscribe to Internet services that offer searches. You can receive a daily report of news items published about the emergency via e-mail.
Identify the journalists who write most about the disaster, and send them detailed information, images, graphics, or resources that can expand their coverage.
Share the most relevant results with national authorities. They can evaluate whether messages adequately represent the sector's mission and operations.
Save samples of coverage of the sector activities and create an archive that can be reviewed after the emergency phase is complete.

4.23 MEDIA RESPONSIBILITIES FOLLOWING THE EMERGENCIES

The work of the media should continue past the peak of the disaster. The challenge is to keep their attention over time.

During the first hours, their presence is overwhelming, but two or three weeks after the disaster, coverage tends to lessen and the predicament of the affected populations can disappear from the informational agenda.

It is precisely when media interest begins to lessen that attention should be given to human interest stories, new angles on stories, updated figures, and reports on advances in recovery and rebuilding.

4.24 PRACTICAL RECOMMENDATIONS

Identification of a date for celebration after the disaster to present new information to attract attention to the prevailing conditions of the affected population.

Identify important national or international dates when disaster themes can be highlighted.
Organize travelling exhibits, concerts or paintings, photograph competitions to attract public and media attention and to keep interest in unmet needs of the affected population.
Sponsor journalism competitions around the disaster.
Identify journalists or media outlets that gave the most coverage to the emergency. Propose that they do stories following the development of the community or family throughout the response phase or they create an ongoing segment that covers the disaster recovery.[142]

142 This chapter has drawn upon the following sources:
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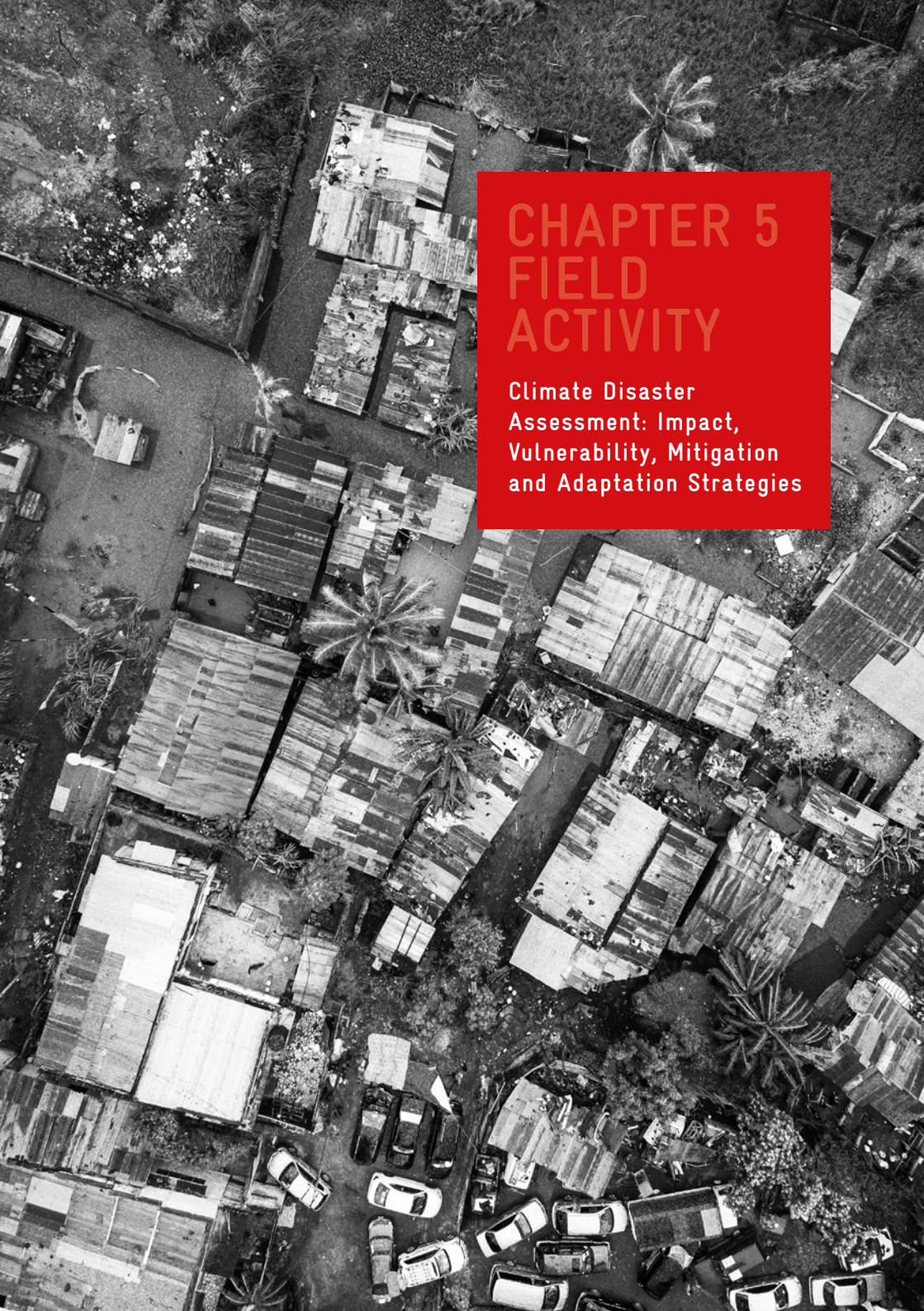

CHAPTER 5 FIELD ACTIVITY

Climate Disaster Assessment: Impact, Vulnerability, Mitigation and Adaptation Strategies

This unit will engage participants in an external assessment of climate-induced disasters and vulnerabilities of selected communities in disaster-prone locations (as shown in Figure 5.1). Additionally, it will engage participants to understand mitigation and adaptation strategies employed on the individual and community levels. This activity involves a field-trip to selected communities to assess the climate risks and disasters of the community and their vulnerability, as well as, existent adaptation strategies. These will help in the promulgation of new technologies and ideas for improving the pre-existing adaptive capacity and actions.

Figure 5.1: Disaster-prone settlement at Aboabo in the Ashanti Region of Ghana.

STUDY APPROACH

Participants shall be divided into groups. Each group shall obtain information on the impacts and adaptive capacity of the community to climate change. Data collection shall consist of a range of data acquisition methods namely direct observation, problem making, participatory mapping and interviews using an interview guide.

Direct Observation

This method, also known as observational study, is used to collect evaluative information for a researcher to assess the problem in the environment without altering that environment. It is used when other data collection procedures are not effective especially if the goal is to evaluate an ongoing behaviour process, event or situation. This method shall be used by the participants during the field trip to observe the direct impact of possible climate risks on the community.

Problem making

Problem making is a participatory technique based on analysis and identification of problems and stakeholders share. In order to implement improvements and solutions to problems faced by communities, one has to first analyse and identify the common problems and priorities of stakeholders. This technique shall be used by the participants during the field trip to decide which of the impacts of climate change on the community is the most important. Afterwards, the participants shall rank the problems in order of their importance. This will provide the baseline information for discussions on possible solutions to the priority issues.

Participatory mapping

Participatory mapping, also community based mapping, is a research technique that combines modern cartography with participatory methods to generate spatial representation of knowledge with local communities. It is based on the premise that local inhabitants possess sufficient knowledge of their environment which can be expressed in a geographical framework for easy understanding.

The approach shall be employed to identify the location of the available resources in the area with a map developed by the locals. Furthermore, the approach shall be used to illustrate existing social infrastructure, land use, patterns, and location of social and natural resources in the community. As part of this technique, members of the community may identify the location and the boundaries of their resources and on land using an aerial photograph. This would help the community members and participants identify the location of various resources on the map in order to determine the changes that have taken place over the years.

Interviews

A set of open ended questions (interview guide) shall be used by participants to assess the vulnerability of the community to the various climate change impacts, and adaptive measures employed by the community to withstand climate-induced risks.

At the end of the field trip, participants shall analyse the data to generate appropriate results to be presented by each group and discussed by all participants.

Expected Outcomes

- Participants shall have observed the possible impact of climate change on the assets and livelihoods of a disaster-prone community.
- Participants shall have assessed vulnerability of the community climate induced risks using direct observation, participatory mapping and interviews.
- Participants shall have observed climate change mitigation strategies adopted by the community and/or made suggestions for improvement on the strategies.

CHAPTER 6 EXERCISES

Module 1: Understanding Ghana's Calamity Profile and Historical Data on Droughts and Floods

1) Ghana's climate is noted to be highly variable and changing. What advice will you provide to a highly dense low lying community with a poor drainage system?

2) With global annual CO_2 concentration and mean annual surface air temperature datasets, analyse the inter-annual to multi-decadal changes and trends in the variables, using the **Earth Policy Institute – Eco-Economy Indicator** spreadsheet. Discuss your observations from the concept of global warming. Estimate their projected impact on general livelihood and sustenance. Additionally, discuss how these global changes are likely to impact on Ghanaian systems.

3) A farming community in the northern part of Ghana in a particular year is confronted with severe drought conditions affecting farming activities and water supply. You have been approached for help. Outline the disaster relief approaches you would employ.

4) Discuss the various climate change barriers. How do these barriers limit the ability to adapt to or mitigate climate change, at the individual, community, regional and national levels in Ghana?

5) As a disaster relief personnel, there is a new developing community seeking your advice to support the community development. On your visit to the community, your first observation was that the community was flood prone and likely to be situated in a fault zone, what strategic advice and support services would you provide?

Module 3: Disaster Risk Management on Droughts and Floods: State-of-The-Art Concepts and Country Cases

1) Discuss the different ways of categorizing disaster risk. Agbogbloshie market is flood prone area and increasing human activity is likely to worsen sanitation conditions, which could trigger health concerns. Outline a relief emergency plan for such a situation.

2) A landslide has been reported from the Adaklu community which has destroyed farms, buildings, utility services and affected human lives. How would you examine the extent of damage and propose relief services that would be needed by Adaklu.

3) Discuss the various ways of classifying climate disaster risk and come out with strategies for providing disaster relief service for a community with low adaptive capacity for flood and drought disasters.

4) Identify a potential disaster risk within the field and classify the risk using indices from the Global Risk Identification Programme provided.

Table 6.1

Class	Criteria						
	Rank	Fatality	Injury	Critical Facility	Proper (houses)	Environmental impact	Socioeconomic impact
Catastrophic	5	>50	>100	Long-term disruption	Wide-spread and severe	Wide-spread and severe	Long-term & wide-spread
Disastrous	4	10–50	50–100	Loss of 50% capacity	Localized and severe	Localized and severe	Extended & wide-spread
Serious	3	5–10	10–50	Closure of a week	Moderate	Moderate	Wide-spread
Moderate	2	2–5	5–10	Closure of a few days	Localized damage	Localized damage	Temporary & wide-spread
Minor	1	<2	0–5	Temporary	Minimal damage	Minimal damage	Temporal

5) Accra is a highly dense city with poor drainage network and most waterways have become built environments. The situation is worsened by the rainfall pattern in that most of Accra's rainfall is stormy and torrential in late May and most of June. As a disaster relief officer, how will you provide a state-of-the-art relief service for identified flooding communities in Accra?

Module 4: Communication and Media Work on Disaster Resilience

1) You have been assigned to a media team to assist in a disaster that has just occurred. Your mission includes gathering data for relief service and providing assistance to the media on appropriate ways of communicating the disaster to the public. Outline your disaster relief strategies to help curb the disaster. Outline the best communication practices.

2) The Asawase community is in most cases inundated by floods. In what ways can NADMO communicate its disaster resilience strategies for the community? How can the media be involved?

3) List the various communication media in Ghana. Discuss how each communication medium facilitates effective communication of flood and disaster risks on district, regional and national scale. What are some of the disadvantages of using each communication medium?

4) What communication issues do you typically face in your disaster relief operations? What strategies do you rely on?

5) In your disaster data gathering mission, what information do you source from people impacted by a disaster? How is this information useful for your disaster relief operation and how is it managed?

About ACRI+

ACRI+ is implemented by MCII and GIZ and financed by BMU and is part of the Promoting Integrated Mechanisms for Climate Risk Management and Transfer programme (ICRM), implemented by GIZ.

For more information, please visit:
http://www.climate-insurance.org/projects/advancing-climate-risk-insurance-acri/

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About MCII

The Munich Climate Insurance Initiative (MCII) was launched in April 2005 in response to the growing realization that insurance-related solutions can play a role in adaptation to climate change, as advocated in the Framework Convention and the Kyoto Protocol. This initiative brings together insurers, experts on climate change and adaptation, NGOs and policy researchers who intend on finding solutions to the risks posed by climate change. MCII provides a forum and gathering point for insurance-related expertise on climate change impact issues. MCII is hosted at UNU-EHS in Bonn, Germany.

For more information, please visit: www.climate-insurance.org/

IMPRINT

Published by
Deutsche Gesellschaft für
Internationale Zusammenarbeit (GIZ) GmbH

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Bonn and Eschborn, Germany

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Programme:
Advancing Climate Risk Insurance Plus (ACRI+)

Picture credits:
© shutterstock / 2563107

ISBN: 978-9988-2-7706-2
9 789988 277062

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