

# ADAPTING TO CLIMATE CHANGE

A PARTICIPATORY WASH FACILITY AND CLIMATE  
RISK ASSESSMENT OF 10 RURAL COMMUNITIES  
IN THE KENEMA DISTRICT OF SIERRA LEONE



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## I. TITLE PAGE

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### III. ACKNOWLEDGEMENTS

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### IV. ABSTRACT

IN AFRICA, CHANGES IN PRECIPITATION AND TEMPERATURE HAVE FUNDAMENTAL IMPACTS ON LIVELIHOODS AS THEY HAVE AN IMMEDIATE INFLUENCE ON PUBLIC HEALTH, WATER RESOURCES AND AVAILABILITY, SANITATION, AGRICULTURE, AND FOOD SECURITY. SIERRA LEONE IN WEST AFRICA IS DUE TO MULTIFACETED FRAGILITY, THE THIRD MOST VULNERABLE COUNTRY IN THE WORLD REGARDING ADVERSE CLIMATE CHANGE IMPACTS. THE PRESENT STUDY AIMS TO ADDRESS SOME OF THESE VULNERABILITIES BY PERFORMING A CLIMATE RISK ASSESSMENT OF 10 RURAL COMMUNITIES WITHIN THE DISTRICT OF KENEMA.

THE RISK ASSESSMENT FOCUSES ON CLIMATE-INDUCED HAZARDS, AGGRAVATING ACTIVITIES AND THEIR IMPACT ON WATER, SANITATION, AND HYGIENE (WASH) FACILITIES WITHIN THE INDIVIDUAL COMMUNITIES.

THE STRUCTURE OF THE CLIMATE RISK ASSESSMENT IS BASED UPON THE METHODOLOGY DESIGNED BY UNICEF AND GLOBAL WATER PARTNERSHIP (GWP) IN THE STRATEGIC FRAMEWORK FOR WASH CLIMATE RESILIENCE, AND THE APPERTAINING GUIDANCE NOTE WASH CLIMATE RESILIENT DEVELOPMENT: RISK ASSESSMENT FOR WASH. PARTICIPATORY WORKSHOPS, INDIVIDUAL KEY STAKEHOLDER INTERVIEWS, FOCUS GROUPS, AND DIFFERENT INTERACTIVE EXERCISES FORM THE BASIS OF THE EMPIRICAL DATA COLLECTION AND FUNCTION AS CAPACITY BUILDING AND AWARENESS-RAISING OF CLIMATE CHANGE IN THE LOCAL COMMUNITIES.

THE STUDY DISCUSSES POSSIBLE ADAPTATION MEASURES IN TERMS OF TECHNICAL, NATURE-BASED, SOCIAL, POLITICAL, AND ECONOMIC-ROOTED SOLUTIONS. ULTIMATELY, THE STUDY REFLECTS UPON THE IMPORTANCE OF ENSURING SUSTAINABILITY WHEN IMPLEMENTING SUCH MEASURES.

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## VII. GLOSSARY

EPA	ENVIRONMENTAL PROTECTION AGENCY
EU	EUROPEAN UNION
EWB-DK	ENGINEERS WITHOUT BORDERS
GDP	GROSS DOMESTIC PRODUCT
GWP	GLOBAL WATER PARTNERSHIP
INTEGEMS	INTEGRATED GEO-INFORMATION AND ENVIRONMENTAL MANAGEMENT SERVICES
LFA	LOGICAL FRAME APPROACH
MDAS	MINISTRIES, DEPARTMENTS, AND AGENCIES
NAPA	NATIONAL ADAPTATION PROGRAMME OF ACTION
NGO	NON-GOVERNMENTAL ORGANISATION
PLA	PARTICIPATORY LEARNING AND ACTION
SEND SL	SOCIAL ENTERPRISE AND DEVELOPMENT SIERRA LEONE
UN	UNITED NATIONS
UNDP	UNITED NATIONS DEVELOPMENT PROGRAMME
UNDRR	UNITED NATIONS OFFICE FOR DISASTER RISK REDUCTION
UNEP	UNITED NATIONS ENVIRONMENTAL PROGRAMME
UNICEF	UNITED NATIONS CHILDREN'S FUND
WASH	WATER, SANITATION, AND HYGIENE
WBG	WORLD BANK GROUP
WFP	WORLD FOOD PROGRAMME
WFP	WORLD FOOD PROGRAMME
WHO	WORLD HEALTH ORGANISATION
WMO	WORLD METEOROLOGICAL ORGANIZATION

## VIII. PREFACE

AS AN INTEGRATED PART OF THE SUSTAINABLE CITIES MASTER'S STUDIES AT AALBORG UNIVERSITY IN COPENHAGEN, STUDENTS ARE ENCOURAGED TO UNDERTAKE A PROJECT-ORIENTED INTERNSHIP IN THE THIRD SEMESTER. THE INTERNSHIP ALLOWS FOR PROFESSIONAL AND PERSONAL DEVELOPMENT AND IS AN EXCELLENT WAY OF APPLYING THEORETICAL AND METHODOLOGICAL UNDERSTANDINGS OBTAINED ON THE TWO FIRST SEMESTERS IN THE SETTING OF REAL-LIFE PROBLEMS (AALBORG UNIVERSITY, N.D).

THE PRESENT STUDY IS PERFORMED ON BEHALF OF ENGINEERS WITHOUT BORDERS DENMARK (EWB-DK) AND MARKS THE ENDING OF THE AUTHORS' PLACEMENT IN THE WATER, SANITATION, AND HYGIENE THEMATICAL NETWORK AT THE HOST ORGANISATION.

EWB-DK IS A TECHNICAL-HUMANITARIAN AND NON-GOVERNMENTAL ORGANISATION (NGO) DRIVEN BY A LARGE GROUP OF PASSIONATE VOLUNTEERS FROM DIFFERENT TECHNICAL DISCIPLINES. THE VOLUNTEERS ARE SUPPORTED BY A SMALLER, PROFESSIONAL SECRETARIAT WHICH DEALS WITH THE DAILY ADMINISTRATIVE WORK AND IS LED BY A BOARD OF DIRECTORS (EWB-DK, 2020). FIGURE 1 HOLDS AN ORGANISATIONAL DIAGRAM OF ENGINEERS WITHOUT BORDERS.

EWB-DK'S GOAL IS TO INCREASE THE LIVING STANDARDS AND CONDITIONS OF THE WORLD'S MOST VULNERABLE PEOPLE THROUGH BOTTOM-UP PROJECTS FOCUSING ON CITIZEN EMPOWERMENT AND LONG-LASTING SOLUTIONS WITH LOCAL ANCHORS (EWB-DK, 2020). COMMON OF THE PROJECT PORTFOLIO OF EWB-DK IS SUSTAINABILITY AND RESILIENCY ESTABLISHED BY CAPACITY BUILDING AND DIRECT INVOLVEMENT OF LOCAL COMMUNITIES AND PARTNERS. THE NGO STRONGLY BELIEVES THAT DEVELOPING LEAST DEVELOPED COUNTRIES' PROFESSIONAL SKILLS IS A CRUCIAL PART OF STRENGTHENING COMMUNITIES. IN THIS WAY, THEY CAN IDENTIFY PROBLEMS AND POSSIBLE SOLUTIONS THEMSELVES REGARDLESS OF WHETHER THEIR POVERTY IS CAUSED BY ECONOMIC OR SOCIAL CIRCUMSTANCES OR ANY OTHER KIND OF MARGINALISATION (EWB-DK, 2020).

THE PRESENT STUDY IS PERFORMED IN CLOSE COLLABORATION WITH EWB-DK'S LOCAL PARTNER SOCIAL ENTERPRISE AND DEVELOPMENT SIERRA LEONE (SEND SL), AN NGO OPERATING IN THE REPUBLIC OF SIERRA LEONE. THE ORGANISATION PUTS GREAT EMPHASIS ON IMPROVING THE LIVES AND LIVELIHOODS OF PEOPLE WITHIN THE COUNTRY THROUGH "[...] HUMAN RIGHTS, ACCOUNTABLE GOVERNANCE, LIVELIHOOD AND NUTRITION SECURITY, THE PROVISION OF EQUAL OPPORTUNITIES FOR MEN AND WOMEN, PROMOTION OF WOMEN'S PARTICIPATION IN POLITICS AND THE ACCESS TO FINANCE FOR ALL." (SEND SL, 2020, P. 4). OTHER CORE ACTIVITIES INCLUDE THE CONDUCTING OF DISASTER RISK MANAGEMENT AND EMERGENCY RESPONSES FOR VULNERABLE HOUSEHOLDS AND COMMUNITIES WHICH ARE LESS PRIVILEGED (SEND SL, 2020).

TOGETHER EWB-DK AND SEND SL HAVE ESTABLISHED A NINE-MONTH INITIATIVE, *ENHANCING CLIMATE RESILIENCE IN RURAL SIERRA LEONE: HOW TO ADAPT THE WASH SECTOR TO CLIMATE CHANGE IMPACTS, IN WHICH THE PRESENT STUDY IS AN INTEGRAL PART*. THE TASK POSED BY EWB-DK AND SEND SL IS TWOFOLD:

1. TO DEVELOP A BOTTOM-UP, PARTICIPATORY METHODOLOGY TO CONDUCT CLIMATE RISK ASSESSMENTS WITH A FOCUS ON WASH IN RURAL AREAS OF THE KENEMA DISTRICT IN SIERRA LEONE

2. TO ASSESS CLIMATE-RELATED RISKS IN 10 RURAL COMMUNITIES WITHIN THE KENEMA DISTRICT USING THE DEVELOPED METHODOLOGY (PILOT TESTING OF THE METHODOLOGY).

THE STUDY AND INTERNSHIP HAVE INCLUDED SIX WEEKS OF FIELDWORK AND EMPIRICAL DATA COLLECTION IN THE KENEMA DISTRICT OF SIERRA LEONE FROM MID-OCTOBER TO THE BEGINNING OF DECEMBER. THE FULL PROJECT DESCRIPTION OF THE EWB-DK AND SEND SL INITIATIVE AND THE APPERTAINING LOGICAL FRAME APPROACH (LFA) IS FOUND IN RESPECTIVELY APPENDIX A AND B.

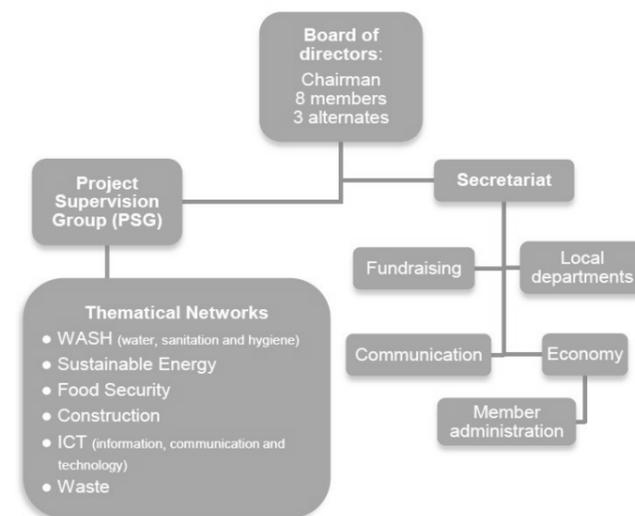


FIGURE 1: ORGANISATIONAL DIAGRAM (EWB-DK, 2018)

## 1. INTRODUCTION

Climate change is a global phenomenon with serious, long-term, cross-sectoral and, in many cases, irrevocable impacts. One of the biggest learnings of the recent decade is that climate change is unjust and ruthless as it seems to hit the most vulnerable the hardest. Particularly climate-related catastrophes recorded in the African continent have shaped the gravity of the phenomenon. Every year, a wide variety of climate change hazards befall within the continent. These climate-induced hazards count among others: coastal flooding and erosion due to accelerating sea-level rise; catastrophic in-land floods caused by changes in precipitation; and extensive droughts as well as widespread wildfires as a result of continuously increasing temperatures and climate variabilities. These incomparable climate-induced hazards are disrupting already frail environmental, societal, political, and economic systems in Africa (WMO, 2021).

If African governance bodies do not initiate adequate risk assessments and adaptation measures by 2030, projections show that an estimate of 118 million people living under the international poverty line will be subject to the abovementioned climate-induced hazards. Likewise, the African economy is at risk of weakening or even collapsing as the cascade effects of climate change are deep-rooted and aggravate the poor existing economic and institutional structures in several parts of the continent. In the sub-Saharan region of Africa, findings show that the Gross Domestic Product (GDP) is prone to further reduce by 3% by 2050 solely due to climate change (WMO, 2021).

Consequently, the continent faces an immense task of adapting to current and future climate variabilities as the design and implementation of robust and adaptive measures must address these cascade effects of climate change impacts without posing an additional burden on the improvement on poverty and substantially obstructing the slow progress of wealth and prosperity growth taking place throughout the continent (WMO, 2021).

A country highly exposed to climate change variability, hazards, and impacts and in desperate need to adapt to these are Sierra Leone in West Africa. The nation has a long history of violence, war, natural disasters, and outbreaks of various highly lethal diseases that have brought the country's economy and technological development to a standstill. In recent years, the correlation between high poverty rates and severe climate change impacts have worsened and are further complicated through low levels of institutional capacity, shortfall of funds, and missing cross-sectoral and interdisciplinary partnerships to ensure apposite adapta-

tion strategies. Due to the high level of multifaceted fragility within the country, Sierra Leone lists as the third most vulnerable nation in the world regarding adverse climate change impacts. Only Bangladesh and Guinea Bissau surpass the West African nation (EWB-DK, 2021: Appendix A).

## 2. CLIMATE CRISIS CONCERNS OF AFRICA AND SIERRA LEONE

Changes in precipitation patterns and rising temperatures are two significant climate-related indicators that have a long-term impact on African livelihoods. Likewise, the indicators are commonly used to describe the status of climate change within the continent due to their substantial influence on public health, water resources, agriculture, and food security (WMO, 2021).

In Africa, temperatures continue to increase at a rate similar to those recorded in the rest of the world. However, 2019 and 2020 are among the top three warmest years accounted for in the continent (WMO, 2021). Figure 2 depicts the trends within the average temperature for the continent and its subregions from 1901 to 2020.

Figure 2: Trends in the average temperature for the subregions of Africa (WMO, 2021, p. 7.)

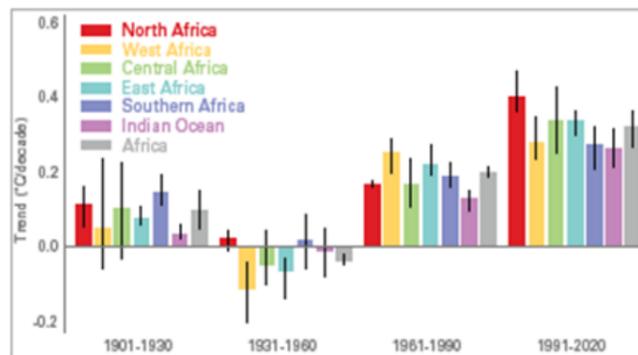


Figure 2: Trends in the average temperature for the subregions of Africa (WMO, 2021, p. 7.)

In terms of subregions, precipitation totals in West Africa were on average higher above the long-term 1981-2010 average in 2020, extending the above-normal conditions seen in 2019 (WMO, 2021).

Changes in temperature and precipitation patterns exacerbate the transmission of contagious diseases throughout the continent as increases in temperature and rainfall nurture the environment for biting insects and the spread of vector-borne diseases, including yellow fever, malaria, and dengue fever (WMO, 2021). Thus, Sierra Leone, and the rest of the African continent, are especially vulnerable to the health effects of climate change as the continent struggles with "[...] climate-sensitive

diseases and low preparedness and adaptive and response capacity at the institutional and community levels." (WMO, 2021, p. 23).

Likewise, livelihoods in Sierra Leone are highly dependent on weather- and climate-sensitive activities, including herding, fishing, and rain-fed agriculture. The capacity to adjust to the climate-induced vulnerabilities to food shortages, income losses, and unemployment are hampered by limited financial buffers, low levels of education, and weak health care structures (WMO, 2021).

Furthermore, climate change and variability bring more extreme weather to the continent and Sierra Leone. Predictions show that Sierra Leone will face an increase in the frequency and severity of climate-induced hazards such as flooding, drought, landslides, wildfires, erosion in the future (WMO, 2021).

### FAST FACTS

# SIERRA LEONE & THE DISTRICT OF KENEMA



Figure 3: Sierra Leone in the African Continent (Moon, 2019)

**ALTHOUGH SIERRA LEONE IS RICH IN NATURAL RESOURCES IN TERMS OF MINERALS AND ARABLE LAND, IT IS NOT A RESOURCEFUL COUNTRY. ON THE CONTRARY, SEVERE DISPUTES ON THE MANAGEMENT OF NATURAL RESOURCES SPARKED AN 11-YEAR CIVIL WAR IN 2002. DURING THE WAR, BLOOD DIAMONDS ADDED CONTINUOUS FUEL TO THE CONFLICT. THE CONFLICT DESTROYED THE FRAGILE FOUNDATION OF THE STILL FAIRLY NEW REPUBLIC, AND EVEN IF PEACE IS RESTORED IN THE PRESENT DAY, THE COUNTRY STILL BEARS DEEP SCARS (MIESEN, 2012).**



Today 43% of the population of approximately 7.977.000 million lives under the international poverty line, and life expectancy is estimated to be 54 years, highly influenced by the high national infant mortality rate (WBG, 2020; The World Bank, 2019). Figures 3 and 4 illustrate the geographical location of Sierra Leone (West African and Sub-Saharan region).

The political jurisdictions and geographical partitioning of Sierra Leone are complicated. Three Provinces and one Area (The North, East, and South Province and the Western Area) divide the county (Government of the Republic of Sierra Leone, 2018), as shown in Figure 5. These Provinces are further divided into 16 districts (Figure 6) which are subdivided into a total of 190 chiefdoms. The structures of the 16 chiefdoms in the Kenema District in the Eastern Province is illustrated in Figure 7.

Figure 4: Sierra Leone (Exploring Africa, n.d.)



Figure 5: Provinces of Sierra Leone (Africa Review, 2018)



Figure 6: Districts of Sierra Leone (Africa Review, 2018)



Figure 7: Chiefdoms of the Kenema District (WFP, 2017)

### 2.1 The Kenema District

The District of Kenema has one of the highest poverty rates (24.2%) in Sierra Leone. The district covers huge rural areas where significant parts of the impecunious population group re-cede. The rural areas are highly vulnerable to climate variabilities because of “[...]their high dependence on rain-fed agriculture and natural resource-based livelihoods.” (Government of the Republic of Sierra Leone, 2018, p. 238).

Accordingly, the agricultural sector has been a central part of much of the humanitarian development work completed in the Kenema District and Sierra Leone in general. However, climate change poses massive challenges to the water, sanitation, and hygiene (WASH) services in the district as well.

### 2.2 Water, Sanitation, and Hygiene (WASH) and Climate Change

Today, climate change is already disturbing the accessibility and quality of drinking water and the standard of hygiene and sanitation services in Sierra Leone and the Kenema District (USAID, 2016). Climate-induced hazards, such as flooding and heavy windstorms, often have a destructive effect on water sources and sanitation facilities. Floods also carry runoff and wastes into water bodies, and in worst-case they contaminate crucial water supplies (UNICEF & GWP, 2017-a). Again, the rural areas are severely exposed as they already have limited access to safe WASH facilities. Concurrently with water points being more frequently polluted, toilets collapsing, and waste dumpsite contaminating entire communities, the rural population is at high risk of losing access to clean and safe water and sanitation services considering the harmful hazards intensify as a direct result of climate change. Consequently, the need for adaption to the existing WASH facilities has never been greater (EWB-DK, 2021).

Focusing on WASH, especially in development work concerning climate change, is crucial as safe water, sanitation, and hygiene services are essential criteria for human life and well-being. WASH addresses fundamental human rights, such as access to clean and safe drinking water.

Moreover, adequate WASH facilities contribute to improving livelihoods, school attendance, and adaptation to climate change (EWB-DK, 2021). Table 1 contains a brief overview of expected changes in climate in Sierra Leone and the Kenema District and their possible impact on WASH services.

Climate change projections of Sierra Leone relevant to the Kenema District	Climate effect	Hazard	Impact on WASH services
Increase in temperatures of 1.0 - 2.5°C by 2060. Rapid inland warming	Increase in temperatures	Heatwaves Drought	Damage to infrastructure, increase in pathogens in water leading to increased risk of the spreading of water- and vector-borne diseases.
The overall increase in rainfall particularly between July and December  The intensity of single rainfall events will continue to increase	Increase in precipitation and viable cloud-bursts	Flooding (Inland flooding, fluvial floods, erosion)	Pollution of wells, inundation of water sources, flooding of latrines, damage to infrastructure, landslides around water sources, increase in sedimentation and turbidity, challenges to the sustainability of sanitation and hygiene behaviours

Table 1: Climate Change and its possible effects in Kenema, Sierra Leone (Government of the Republic of Sierra Leone n.d. & USAID 2016)

In addition to climate change, the population of Sierra Leone will rapidly increase in the coming future, adding further stress on WASH services (Government of the Republic of Sierra Leone, 2018). Likewise, when talking of the stains of the services, it is critical to address the state of the existing water supply and sanitation facilities in the country. In Sierra Leone, the general conditions of WASH services are poor. Facilities are often not functioning sufficiently or are out of use. Missing technical and logistical capacity are common causes of the malfunctioning facilities, which only adds to the population's vulnerability towards withstanding the impacts of climate change (EWB-DK, 2021).

## 3. PROBLEMSTATEMENT

Climate change and viability, a rapidly growing population accompanied with weak WASH services set high demands for future adaptation plans in Sierra Leone. Until recently, agriculture has been the vital focal point of most climate change adaptation and recovery initiatives. However, water, sanitation, and hygiene (WASH) services are starting to gain a foothold as crucial infrastructures to focus on in adaptive efforts, especially in the light of recent climate-induced disasters reported in the continent of Africa. Despite this, there is a consensus that the implementation of adaptation measures must be accelerated in Sierra Leone if irrevocable impacts are not to destroy the faltering foundations of the Republic and the already vulnerable rural communities.

A way of accelerating this transition is by assessing local climate change impacts through the performance of climate risk assessments. These assessments enable decision-making bodies to appraise what measures are needed to overcome the identified climate-related risks. Thus, the findings of the assessments function as justification that aims to ensure that decisions on how to construct sustainable adaptation solutions are properly informed (UNICEF & GWP, 2017-a).

The present study is a participatory WASH facility and climate risk assessment of 10 rural communities within the Kenema District in the Eastern Province of Sierra Leone. The assessment centres on how community members experience local impacts of climate change. The study investigates the influence of aggravating activities undertaken by the communities on the identified local impacts of climate change. Lastly, it discusses possible adaptational measures that can strengthen the communities.

Thus, the objective of the present study is threefold:

1. To analyse how the communities are experiencing climate change and how they are locally impacted by climate-related hazards and investigate how these affect the WASH facilities and other principal infrastructures in the 10 selected communities within the Kenema District in Sierra Leone.
2. To examine human-induced activities undertaken by the communities and how these might aggravate the local impacts of the experienced climate change hazards.
3. To discuss how the communities can adapt to the identified climate-induced hazards and how the implementation, effectiveness and acceleration of adaptation strategies entail deep structural reconstructing on a national level.

These objectives lead to the following Research Question and Sub-questions.

# RESEARCH QUESTION

**How are climate change impacts experienced locally within rural communities in the Kenema District of Sierra Leone, and how can the communities adapt to these challenges?**

### SUBQUESTION 1

How is climate change impacting the 10 selected communities and their WASH facilities?

### SUBQUESTION 2

What human-induced activities do the selected communities take part in, and how do they aggravate the impacts of climate change?

### SUBQUESTION 3

How can the communities adapt to the local impacts of climate change, and what are the barriers?

### 3.2 Research Design

As stated previously, the structure of the present study is defined by the above Research Questions, Sub-questions, and objectives. The Research Design is illustrated in Figure 8.

# RESEARCH DESIGN

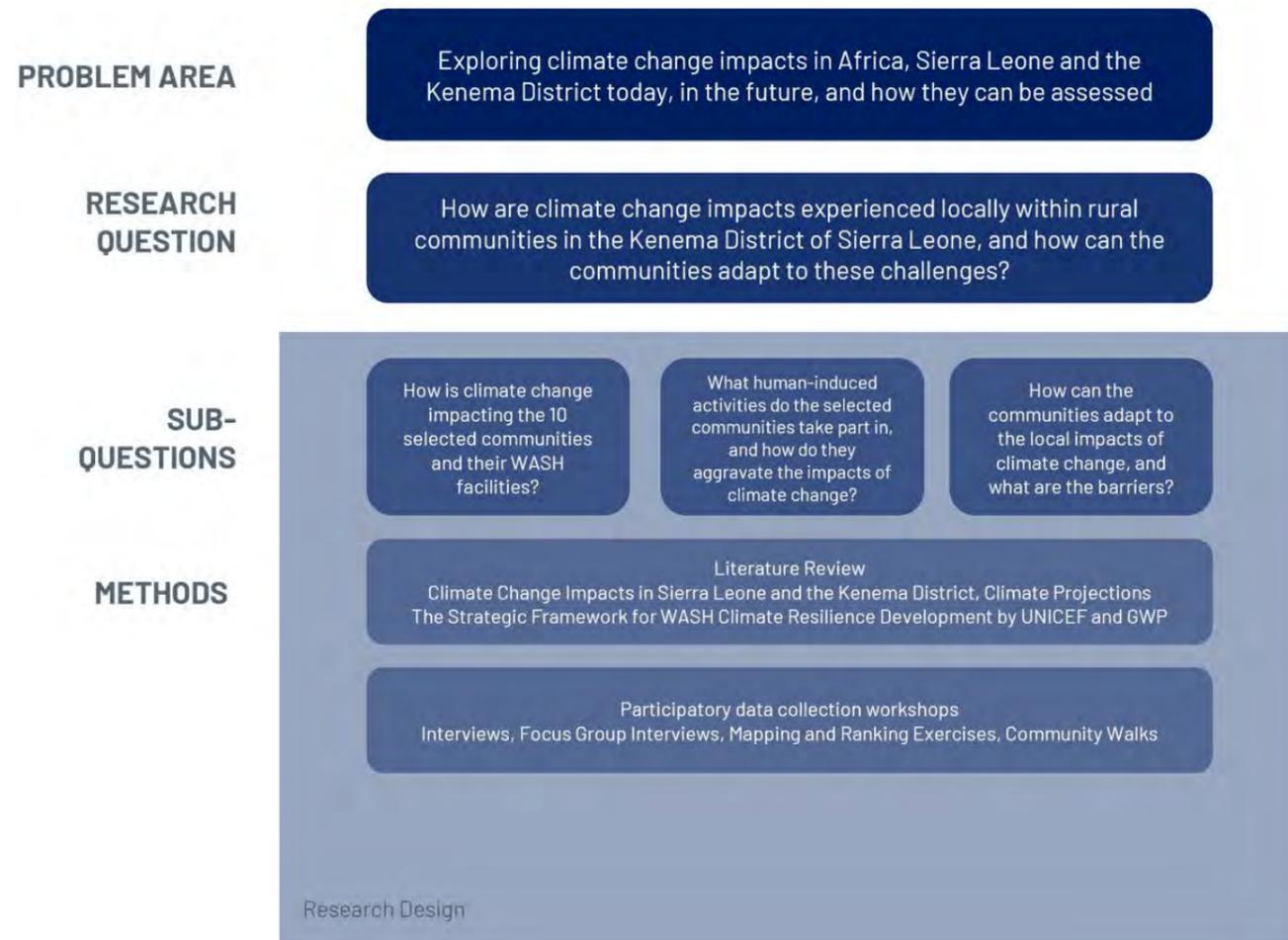


Figure 8: Research Design

## 4. THEORETICAL CONSIDERATIONS

**THE THEORETICAL FRAMEWORK OF THE PRESENT STUDY INCORPORATES THEORETICAL CONSIDERATIONS EXPRESSED BY FRANK FISCHER IN *CITIZENS, EXPERTS AND THE ENVIRONMENT: THE POLITICS OF LOCAL KNOWLEDGE FROM 2000*. THE BOOK HOLDS FOUR PARTS; I. *CITIZENS AND EXPERTS IN THE RISK SOCIETY*; II. *ENVIRONMENTAL POLITICS IN THE PUBLIC SPHERE*; III. *LOCAL KNOWLEDGE AND PARTICIPATORY INQUIRY*, AND IV. *DISCURSIVE INSTITUTIONS AND POLICY EPISTEMICS* (FISCHER, 2000).**

This section elaborates upon the central theoretical deductions from part III, as these constitute the guidelines and justification of the methodological choices of the present study explained in section 5. *Methodology*.

### 4.1 The Genesis of Participatory Research

In academic research, there has long been a dispute between researchers affiliated with the conventional research paradigms of professional expertise and researchers of democratic governance practices such as Participatory Inquiry. Participatory Inquiry, colloquially Participatory Research, can be understood as an immediate outcome of the critique directed at professional expertise, that is, professional experts allying themselves with elite interests “[...] *directly on the expense of local citizens* [...]” (Fischer, 2000, p. 170). Participatory Research addresses this critique by centring on the participation of civil societies in research matters (Fischer, 2000).

Participatory Research stems from many different approaches and carries elements of several theories, methodologies, and movements such as Advocacy Research, the collaborative methodology of Action Research and the New Social Movements. Although, the predominant development and first conceptions of Participatory Research trace back to the 1970s. At this time, conventional economic and agricultural initiatives failed to meet their objectives of reducing or eliminating inequality and poverty (Fischer, 2000). As a result, “*Researchers began to develop alternative approaches that increased the participation of the poor in development programs and aimed at empowering poor rural and urban communities as well as improving the standard of living.*” (Cancian and Armstead (1992, 1,427) in Fischer, 2000, 173). Today the approach is often employed when conducting research or initiatives on progressive or radical empowerment by raising awareness on the specific cause, educating involved stakeholders, and advocating for political actions or societal changes (Fischer, 2000).

The many origins of Participatory Research make it difficult to distinguish just one approach which captures all concepts and dimensions of the research theory. However, common to the different approaches is a shared epistemological point of view which states that humans co-create “[...] *their own reality through participation: through their experience, their imagination and intuition, and their thinking and action.*” (Re-

ason 1994, 324 in Fischer, 2000, p. 175). Thus, Participatory Research allows individuals whom the research revolves around, to some degree, to shape the outcome of the given study through their participation (Fischer, 2000).

### 4.2 Principles of Participatory Research

Participatory Research has, according to Fischer (2000) “[...] *developed as an empowerment strategy designed to help less-privileged citizens in their struggles to better understand and confront the realities and choices that shape their own interests and concerns.*” (Fischer, 2000). In many ways, Fischer (2000) recognises the value of civil society and concurrently argues strongly for including citizen knowledge, experiences, and ideas, as it can combine local challenges with the correct technical and scientific solutions and explanations. Thus, civil society both supports and creates academic research. Accordingly, civil societies play an essential role in gathering valid and reliable empirical data in Participatory Research (Fischer, 2000).

On the other hand, opponents of Participatory Research argue that as participants from civil society provide data for the given study, there is a high risk of the data being invalid or biased, as political agendas might influence their viewpoints (Fischer, 2000). This criticism is a common standpoint provided by professional experts who believe that research done by scientists is more impartial and unbiased than research based on citizen knowledge and citizen participation. That is why a strong focus and awareness towards being impartial should guide the researcher when conducting Participatory Research (Fischer, 2000).

### 4.3 Participatory Research in the Global South

Fischer argues that citizens should not bear the burden of dealing with insurmountable technical questions, especially in the Global South, where time and resources are precious (Fischer, 2000). However, performing Participatory Research in the Global South demands extensive planning that considers civil societies, counting their abilities, time and energy that they can allocate to the given study. These are essential factors to reflect upon to ensure that the research is not conducted at the expense of the civil society and participants and make sure that it is not only the researcher that benefits from the practice (Fischer, 2000). Researchers should implement participatory principles only for the sake of participation as it can lead to more wasted time and effort than is advisable in more technical problems (Fischer, 2000).

For this reason, the data collection methodology of the present study is adapted to the theoretical considerations by Fischer (2000) with a focus on giving civil society (the communities) a significant role in the data collection of the climate risk assessment to ensure that the problem area is elucidated from the viewpoint of them while not troubling the participants unnecessarily regarding time and resources. Section 5.2 *Participatory Data Collection* elaborates upon the participatory elements of the empirical data collection.

## 5. METHODOLOGY

**THIS SECTION PRESENTS THE METHODOLOGY USED FOR UNDERTAKING THE PRESENT WASH FACILITY AND CLIMATE RISK ASSESSMENT. THE OVERALL FRAME AND STRUCTURE OF THE ASSESSMENT DRAW ON KEY CONCEPTS FROM THE STRATEGIC FRAMEWORK FOR WASH CLIMATE RESILIENCE AND THE APPERTAINING GUIDANCE NOTE WASH CLIMATE RESILIENT DEVELOPMENT: RISK ASSESSMENT FOR WASH DEVELOPED BY UNICEF AND GLOBAL WATER PARTNERSHIP (GWP).**

To align with the theoretical views of the present study and to emphasise and ensure sustainability and building capacity and local ownership of the initiative, the concepts from the strategic framework are coupled with principles from Participatory Learning and Action (PLA). The strategic framework and the ideas behind PLA have equally played an essential role in the development and general structures of the present study and fieldwork.

The method has been developed to create an understanding of the connection between climate change, aggravating behaviours and the impacts that the communities are experiencing and will end up highlighting the climate risks and the steps that can be taken towards creating more resilience. The process of piecing together a functional methodology for that purpose has therefore been elective and iterative, focusing on some aspects of UNICEF and GWP's strategic framework, building on the theoretical foundation of participatory research coupled with principles from PLA.

The following sections elaborate upon methodological considerations and choices of the abovementioned concepts and principles and can be used as a step-by-step guide on how the methodology was developed and later applied in practice.

### 5.1 The Strategic Framework for WASH Climate Resilience Development

The framework centres on one focal point: *to ensure sustainable, reliable, and robust WASH services today and in the future.* Climate-resilient development is the emphasis of the framework, which includes improving the resilience of WASH systems. Climate resilience is treated as a cross-cutting issue comprising parts of disaster risk reduction and climate change adaptation, and it incorporates both development and emergency preparation of the involved sectors (UNICEF & GWP, 2017-a). The framework is not a new process; however, it advances from traditional sectorial divided planning approaches by building bridges between

WASH and climate change, incorporating environmental, social, and economic aspects. Consequently, the framework seeks to inform and improve current planning practices and should be seen as a resource for the WASH sector, according to UNICEF and the GWP (UNICEF & GWP, 2017-a).

The framework aims to establish reasonings and principles for WASH climate-resilient development, as well as to improve the understanding of how to incorporate climate resilience into WASH strategies and plans. The framework recognizes the WASH sector's multi-level governance structures, acknowledges that each has a unique role to play in delivering WASH-based outcomes, and endorses that climate resilience must be addressed at all levels (UNICEF & GWP, 2017-a).

The Strategic Framework for WASH Climate Resilience centres on how WASH services in rural areas are impacted by climate change. The Framework consists of four quadrants of activity to ensure resilience:

- **“Understand the problem:** This covers the various elements that help to understand the risks climate change poses to the WASH sector.
- **Identify and appraise options:** This covers the identification and appraisal of options to improve climate resilience.
- **Deliver solutions:** This covers the integration of options into existing strategies and plans and their implementation.
- **Monitor and move forward:** This covers monitoring and the lessons learned from the implementation of climate-resilient development activities.”

(UNICEF & GWP, 2017-a).

As the main objective of the present study is to conduct a climate risk assessment in 10 rural communities, the development of the methodology and structure of the study have mainly drawn inspiration from the first activity, *Understand the problem.* The three remaining activities have not played a significant part in the present study as these activities are referring to tasks exceeding the scope and aims of the study. However, as the study is a part of an ongoing initiative by EWB-DK, it is recommended that the organisation includes and follows these activities in the later processes.

A graphical illustration of the Framework is shown in Figure 9.

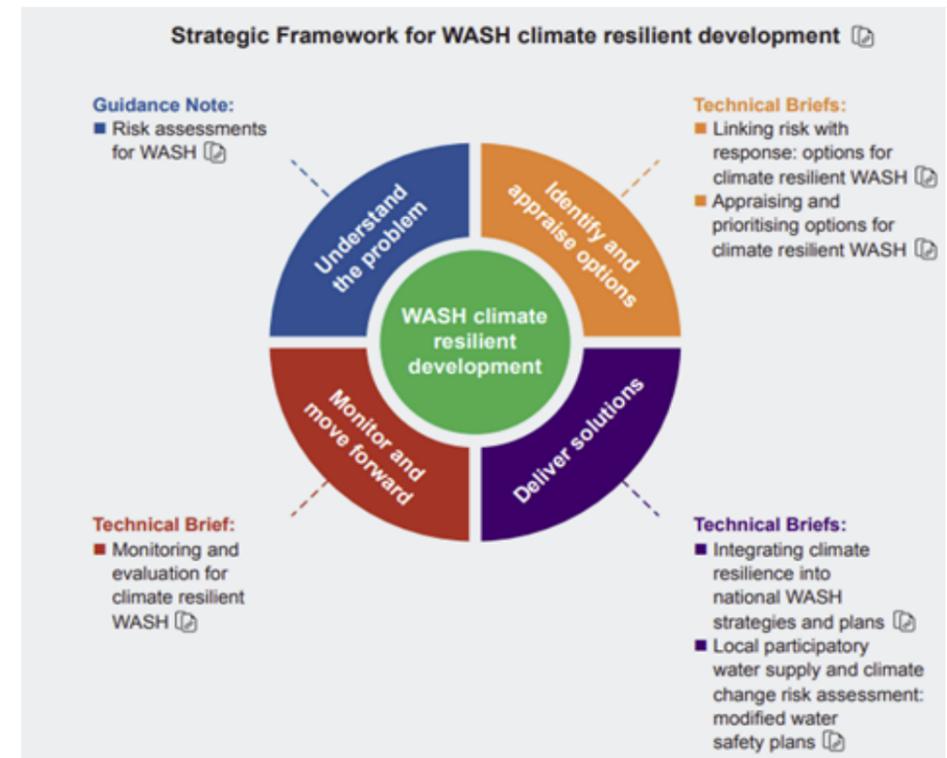


Figure 9: Structure of the WASH Climate Resilient Development Strategic Framework (UNICEF & GWP, 2017-a).

#### Understand the problem

*Understand the problem* deals with elements that build an understanding of the climate change risks posing threats to the WASH sector and its services (UNICEF & GWP, 2017-a). The activity has three main tasks, which are described and related to the present study in the next three sections.

1. **Reviewing existing climate change-specific strategies, plans, and studies,** not only at the WASH sector level but also at national and local levels, to acknowledge the outlined priorities and the overall risks in which climate change and variability pose

2. **Stakeholder engagement,** particularly at the local and community level to improve understanding of the climate hazards, vulnerabilities, and exposure, including roles and responsibilities of stakeholders in the chosen area of interest

3. **Climate risk assessment:** Identifying and understanding the uncovered climate hazards, vulnerabilities, and exposure and the current capacities to address these. (UNICEF & GWP, 2017-a).

#### Reviewing existing strategies, plans and studies

To comprehend the current development and priorities regarding the adaptation of WASH services it is crucial to identify plans and strategies in which they are described. This belief also supports the identification of opportunities to ensure that existing programmes are used to address climate resilience. Furthermore, it strengthens the case for new investment strategies to promote climate resilience and narrows the area of future research (UNICEF & GWP, 2017-a). Likewise, reviewing secondary sources is the first step in PLA methods as well, and according to Mikkel-

sen (2005), *“It is a crime in research and development work not to allocate time for prior documentary studies.”* (Mikkelsen, 2005, p. 87).

In practice, a preliminary literature review of leading publications has been carried out in the present study. The primary sources have been public, national, and international reports on climate, health, and WASH in Sierra Leone. Reliable websites and innovative, interactive online platforms describing the climatic hazards for Sierra Leone have also functioned as vital informative sources. Together, these references have illuminated the study on how the climate of Sierra Leone has developed and which WASH facilities the rural population has access to, as well as the likely consequences of climate change.

#### Stakeholder engagement

According to UNICEF and GWP, stakeholders are defined as a more generalist group of people opposing expert elicitations (UNICEF & GWP 2017-b), while Mikkelsen defines it as *“[...] individual persons, groups or institutions with vested interests in an intervention.”* (Mikkelsen, 2005, p. 72). Regarding the initiative established by EWB-DK and SEND SL, in which this study takes part, the primary stakeholders are the population of the selected 10 communities, as these are directly affected by the implementation of the initiative. They are also key stakeholders, as they can significantly affect the outcome of the intervention, and they share the *responsibility, quality and sustainability* of the ongoing initiative (Mikkelsen, 2005).

Other stakeholders count Ministries, Departments and Agencies (MDAs), such as the Water Directorate and the Environmental Protection Agency (EPA) in Sierra Leone. The MDAs are secondary stakeholders, as they are not directly impacted by the deliverables of the intervention but engaged

to ensure their buy-in and acceptance of the initiative. However, they are key stakeholders, as they hold great influence over the general WASH implementations within the District of Kenema and have agreed to take responsibility to improve the agenda of mitigating impacts of climate change, promote adaptive measures in new interventions as well as ensuring the sustainability of such initiatives.

EWB-DK and SEND SL are categorised as secondary but key stakeholders as they have a substantial impact on the initiative under their function respectively as the donor and the implementing party without being a primary stakeholder as they are not beneficiaries of the intervention. In practice, stakeholder engagement has been managed through firstly the identification of stakeholders within the study, and secondly through meetings, workshops, exercises, training sessions, entry-level meetings, and data collection workshops with relevant, involved stakeholders, which all took place as a part of the fieldwork in Sierra Leone. A thorough list and description of MDAs and other relevant stakeholders are found in Appendix C.

### Climate risk assessment

The final task under the activity *Understand the problem* is to conduct a climate risk assessment. A climate risk assessment is a methodology to evaluate potential climate-related hazards and existing conditions of vulnerability that could harm livelihoods (UNICEF & GWP 2017-b). In the present study, the climate risk assessments of the 10 communities are based on data collected from the participatory data collection workshops combined with the information found in the preliminary literature review based on scientific, literary sources.

In relation to the climate risk assessment, UNICEF and GWP have developed the guidance note, *WASH Climate Resilient Development: Risk assessment for WASH*. The guidance note is an in-depth exposition of how to understand, group, and assess WASH-related climate risks (UNICEF & GWP, 2017-a).

Using the terminology and approach presented by UNICEF and GWP in the guidance note, risk can be defined and calculated as a mathematical equation consisting of three variables:

$$Risk = Hazard \times Vulnerability \times Exposure.$$

In the present study, the definition of *risk* builds upon the concept presented by UNICEF & GWP (2017-a) but is slightly altered to consist of the following three variables.

$$Risk = Hazard \times Aggravating Activity \times Exposure.$$

Additionally, a fourth variable, *capacity*, influence risks. However, UNICEF and GWP states that *“Capacity is not used in the equation but assessed separately to help prioritise risks for identifying resilient options.”* (UNICEF & GWP, 2017-b). Thus, it is critical to identify and understand these variables to assess a given climate-induced risk and later determine the best ways to improve climate resilience and adaptive capabilities to address the impacts (UNICEF & GWP, 2017-a).

However, the present study does not implement all aspects of the approach presented in the strategic framework. While the Framework recommends assigning confidence scores concerning how reliable certain information retrieved for the climate risk assessment is, the present study assesses risks in a more inclusive, participatory-friendly, and open-minded manner.

Following the approach of the Framework, high confidence scores should be assigned to answers that are *“Based on reliable information or analysis with a strong theoretical basis and widely accepted within the sector.”* (UNICEF & GWP, 2017-b, p. 18). While low confidence scores are assigned to *“[...] anecdotal evidence, or very basic estimation methods.”* (UNICEF & GWP, 2017-b, p. 18).

This viewpoint is highly contradicting the theoretical considerations and mindset of participatory research applied in the present study. Thus, following the approach set out by UNICEF and GWP would undermine the findings of the present study as a majority of the information used for the climate risk assessments are retrieved from statements, anecdotes and observations made by local people as well as their abilities to connect social and technical observations. Based on these contradictions, the present study will assess climate risks based on the data retrieved from the participatory data collection workshops coupled with scientific findings from academia without assigning confidence scores.

Furthermore, the developed approach in the strategic framework does encourage prior studies to be done and substantiating the knowledge

extracted from participatory research with scientific sources, the local communities involved in the present study will not likely be able to conduct such research due to lack of resources (books, computers, internet, power) and education.

In the light of these findings, it was decided that the overall frame of data collection method for the 10 climate risk assessments should be (partly) founded on identifying these four variables. To ensure stakeholder engagement, capacity building and awareness-raising of climate change and its local impact, participatory principles from PLA are chosen as the guiding frames for developing the data collection workshops. The structures of the participatory data collection methods are further described in the following sections.

### 5.2 Participatory Data Collection

As mentioned above, participatory data collection workshops conducted in the selected communities form a central part of the data collection for the climate risk assessments of the present study. The participatory workshops consist of different exercises carried out in two focus groups and three to four individual, key informant interviews carried out in parallel to the focus groups. The two focus groups are divided into gender and involve eight women and eight men in each community. The interviewed key informants include the town chief, the women's leader, and the youth leader. In some communities, societal heads or section chiefs are likewise interviewed to gather community-rooted information. Descriptions of these information roles within the community are found in Appendix C. Table 2 to 8 and Figure 10 to 23 gives an overview of the workshop exercises done in each focus group and with each key informant. The following sections elaborate further upon the different exercises.

Exercise 1 Community Description, Mapping, and Knowledge Assessment			
What	Who	Objective(s)	Duration
Description of the community, its name, location, and population	Focus groups 3 – 4 Key informants	To gain a general knowledge of the community	5 minutes
Knowledge assessment	Focus groups 3 – 4 Key informants	To assess how much participants know about climate change and its impacts before the workshop	5 minutes
Community Mapping	Focus groups	To gain a general understanding of the community	15 minutes

Table 2: Exercise 1

Exercise 2 Identifying WASH Facilities in the Community			
What	Who	Objective(s)	Duration
Focus group social mapping	Focus groups	To assess where WASH facilities are located within the community	15 minutes
Focus group questionnaire and ranking exercises	Focus groups	To assess the state of the facilities, the state of resilience and the capacity with what to maintain and care for the infrastructure	1 hour

Table 3: Exercise 2

Exercise 3 Climate Change-related Hazards			
What	Who	Objective(s)	Duration
Climate-related WASH Hazard Participatory Mapping	Focus groups	To assess where in the community climate-induced hazards are taking place	15 minutes
Questionnaire and ranking exercises	Focus groups	To assess the characteristics and the impact of the hazards. Identifying coping strategies and actions	30 minutes

Table 4: Exercise 3

Exercise 4 Aggravating human-induced activities			
What	Who	Objective(s)	Duration
Aggravating activities Participatory Mapping	Focus groups	To assess where in the community aggravating human-induced activities are taking place	15 minutes
Questionnaire and ranking exercises	Focus groups	To assess the characteristics of the aggravating activities and their impact. Identifying coping strategies and actions	30 minutes

Table 5: Exercise 4

Exercise 5 Facility Assessment			
What	Who	Objective(s)	Duration
Community walk	5 people from key informants to community participants.	Identify key areas in the map, that can show where WASH infrastructure is at risk from climate change, not working and where aggravating activities are taking place – to document and observe	30 minutes

Table 6: Exercise 5

Exercise 6 Individual Key Informant Interviews			
What	Who	Objective(s)	Duration
Key informant interview	3 – 5 key informants	To gain knowledge of existing community plans regarding climate change, and resilience in WASH	20-30 minutes

Table 7: Exercise 6



Figure 11: WASH facility mapping in Bongor, women's focus group (own picture)



Figure 14: Facility assessment in Foindu Mameima, old mining pit



Figure 15: Facility assessment in Faama, on the way to visit toilet facilities



Figure 13: Aggravating human-induced activities mapping in Faama (own picture)



Figure 12: A ranking exercise in Bongor, women focus group (own picture)



Figure 10: Community Mapping in Bongor, male focus group (own picture)



Figure 16: Key informant interview of Women's Leader in Bongor (own picture)

### Social Mapping

Social mapping is a method employed in the field of development work and research. Usually, the mapping is conducted in smaller groups and is followed by a group discussion. The aim of the mapping exercises is often to identify and understand specific structures within a community. Thus, the mapping exercises are used as a visualisation tool to indicate vital landmarks in the view of the participants. Social mapping can be used in connection with different kinds of ranking, such as wealth ranking indicating with dots which households are the wealthiest and which are not (Mikkelsen, 2005).

In this study, the mapping exercises focused on creating spatial awareness with participants and facilitators of the given communities. By asking the participants to map out the facility in question, it created a better understanding of the subject in the following exercises

As shown by the above tables and pictures, the current study uses social mapping for gathering information on the structures of the communities with a special focus on mapping WASH facilities, climate-related hazards, and aggravating human-induced activities (exercises 1 to 4). The mapping exercises were done in divided focus groups, where the participants should draw the structures of their communities, such as community boundaries, houses, schools, roads, rivers, and forests (exercise 1). Afterwards, they indicated the location of their WASH facilities (exercise 2). In exercise 3, the participants mapped where the identified climate-related hazards occurred while specifying the aggravating activities in exercise 4. All mapping exercises were done on the same piece of paper. Thus, at the end of the workshop, each focus group had produced one detailed map. Figures 18 to 20 show the stages of the social mapping in the female focus group in Ngewahun. Figure 21 illustrates the final map in the male focus group Ngewahun. As illustrated in the figures, the final maps can be very different even though it exemplifies the same community.



Figure 17: Community mapping in Foindu Mameima, women's focus group (own picture)



Figure 18: Community mapping of Ngewahun with WASH facilities, the end of exercise 1 and 2 in the female focus group (own picture)



Figure 20: Final community map with aggravating, human-induced-activities (deforestation) in Ngewahun, end of exercise 4 in the female focus group (own picture)



Figure 19: Community map with climate-related hazards (wind) in Ngewahun, end of exercise 3 in the female focus group (own picture)

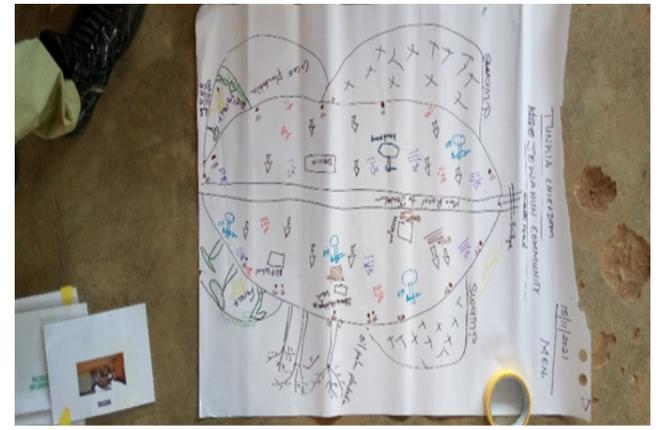


Figure 21: Final map of Ngewahun in the male focus group (own Picture)

## 6. How are the communities impacted by climate change?

### Mapping WASH infrastructure

When the focus groups had successfully completed exercise 1, the next step was to identify and map WASH facilities within the community. The WASH facilities were given specific colours that would distinguish them clearly from each other and appertaining abbreviations to indicate the type of facility, as listed below.

Blue: Wells (W), Hand Pump (HP), Water Storage (WS)  
 Red: Waste Dumpsite (WDS)  
 Brown: Toilet Facilities (TF)  
 Black: Gutters/drainage (G/D)

Furthermore, the participants were given flashcards illustrating the WASH facility and the colour assigned. Figure 22 below shows an example of such a flashcard. Appendix D contains all used flashcards in the participatory data collection workshops.

### Mapping Climate Change Hazards and Aggravating activities

In the third and fourth exercises, the participants were introduced to new flashcards depicting climate change hazards and aggravating activities. The flashcards have the same design as shown in Figure 22 above, meaning they could find illustrations of the hazards or activities on one side and a short description as well as an assigned colour on the backside. The participants should then map hazards and activities within their communities on the same map from exercises 1 and 2. In this way, the maps will create a deeper understanding of how hazards and activities impact the existing WASH facilities. The assigned colours for the hazards and activities are listed below in Table 8.

### Ranking and scoring

After the physical mapping of hazards and activities, the participants went through a scoring exercise to identify the most critical impacts in the respective communities. In practice, the flashcards of the identified and mapped hazards were laid out in front of the participants, whom each had five votes (dry beans) to distribute on the hazards. The participants were free to split votes between different flashcards understanding that votes were a sign of the severity of the given hazard. The participants went through the same procedure for the activities. After the facilitators identified the two highest-ranking hazards and activities (those with the most votes), the focus groups discussed these in detail through an online questionnaire.

### Facility assessment and Community walk

The facility assessment and community walk is an exercise where a few representatives from the two focus groups, together with the data col-

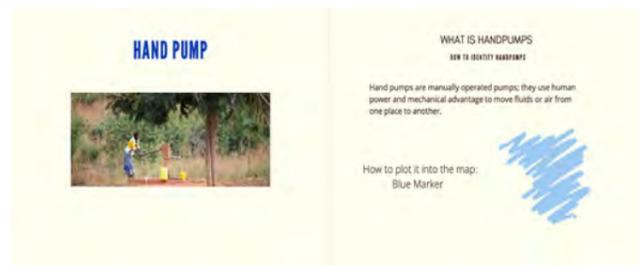


Figure 22: Front and backside of flashcard indicating WASH facility, Hand Pump

	Hazards	Abbreviation	Colour
Hazards	Landslide	(L)	Brown
	Flooding	(F)	Blue
	Drought	(D)	Yellow
	Wildfire	(W)	Red
	Waste disposal	(WD)	Orange
	Windstorm	(WS)	Purple
	Erosion	(E)	Brown
Aggravating Activities	Deforestation	(D)	Green
	Water pollution	(WP)	Purple
	Mining	(M)	Pink
	Use of pesticides/fertilizers	(P/F)	Black

Table 8: Colours, the abbreviations of hazards and aggravating activities

lecting team, stroll through the community to assess and discuss some of the items mapped in the previous exercises. This exercise is performed to gain a deeper understanding of how some spaces are used, if the inhabitants feel safe or not, and if they have taken any measures to mitigate risks.

Mapping WASH facilities, hazards, and activities on the same map enable the facilitators and participants in unison to pick relevant sites to visit within the communities. The guiding principles of choosing visits were to assess: 1. WASH facilities out of order, 2. WASH facilities impacted by either hazard or aggravating activity, 3. Areas affected by a climate-related hazard, and 4. Areas influenced by human-induced aggravating activities.

**THE FOLLOWING ANALYSIS INVESTIGATES HOW CLIMATE CHANGE IMPACTS THE TEN LOCAL COMMUNITIES AND THEIR WASH FACILITIES. THE ANALYSIS UTILISES SCIENTIFIC LITERATURE BUT EMPHASISES THE DATA COLLECTED IN THE PARTICIPATORY WORKSHOPS TO FULLY CAPTURE HOW THE COMMUNITIES ARE EXPERIENCING CLIMATE CHANGE AND TO WHAT EXTENT IT IMPACTS THEIR WASH FACILITIES AND OTHER PRINCIPAL INFRASTRUCTURES.**

### 6.1 Windstorms

In practice, a tropical storm is an established centre of low pressure which develops over tropical, warm seas (Zehnder, 2011). They are a part of "[...] tropical weather systems and have the potential to produce strong winds along with torrential rainfall and associated storm surge near the centre of the storm." (HARPIS SL, n.d.).

In Sierra Leone, tropical storms occur annually, especially during the rainy season. According to HARPIS SL (n.d.), the Kenema District is at moderate risk of being exposed to tropical storms (HARPIS-SL, n.d.). In the present study, eight out of 10 communities experience windstorms. They all report the hazard at different times of the year, January and December being the only months where the hazard would not affect the communities. Generally, windstorms tend to impact housing structures the most, usually in terms of damaging roofs.

However, heavy wind also impacts WASH facilities, especially toilets, as these are likewise often constructed with poor roofing. According to one focus group in Semewabu, the community is poorly protected against climate change "Because there is no forest." (Appendix E). This statement could indicate that the community regard the forest as a protective, natural windbreak. Hence a solution to improve resilience towards windstorms is to plant trees around the community.



Figure 25: Toilet facility in Semewabu (own picture)

Something similar seems to be the problem in the communities Geima and Ngewahun. In these communities, they also report on toilet roofs being destroyed by the wind. In Majihun, however, one focus group reports that their toilet facilities are well protected from windstorms as "[The toilets] height is [lower] than the height [of the] houses. So that when there is a windstorm, the wind will jump over [the toilets]." (Appendix E). One reason why toilet facilities may be more exposed to windstorms than other facilities is that they are often poorly built or constructed by non-robust and climate-sensitive materials such as mud, sticks and zinc, see Figures 24 and 25. As a result, several communities report that they need concrete or other materials to strengthen the structures of the toilet facilities. As an example, participants from Semewabu suggest to: "Take the carpenter to repair the toilets by fixing those weak sticks (red)." (Appendix E), which do indicate that the toilets are primarily in a somewhat poor condition.

In the remaining communities, Faama, Kongohun, Diama and Njama, the wind does not appear to be impacting their toilet facilities, which could be because they all are located in the forest, shielding them from severe impacts of the hazard or that their toilet facilities are constructed by more robust materials like the ones in Faama, see Figure 26. Also, Ngewahun, Geima and Semewabu are located on hills which could increase the likelihood of them experiencing more wind than the abovementioned communities. Majihun is the only community not located on either a slope or in a forest. However, they do speak of extensive deforestation near the community when they state: "There have [been] a forest, but it's no longer existing." (Appendix E), which in turn would make them more susceptible to windstorms as likewise reported in Semewabu.



Figure 24: Toilet facility in Majihun (own picture)



Figure 26: Toilet facilities in Faama (own picture)

## 6.2 Erosion

Erosion is a natural, geological phenomenon where stone, clay, sand, and mud are carried away by wind and water. A brown colour in the breeze or water can indicate whether erosion takes place or not and that earthen material is being moved from one place to another. This transported material is known as sediment (Sue, 2018).

Sierra Leone is highly impacted by coastal erosion as both human-induced activities and natural forces are destroying the coastal lines of the country (HARPIS-SL, n.d.). However, coastal erosion is the only type of erosion that has been assessed by HARPIS-SL, which for obvious reasons, do not affect the Kenema District as the district lies inland.

Within the District of Kenema, it is extremely difficult to paint a detailed picture of how, when and where erosion is happening as it is nearly impossible to retrieve reliable and trustworthy information from previous assessments, analyses, or records (CIDEMEWS-SL, n.d.). Nevertheless, six out of 10 communities in the present study report incidents of erosion. The impacted communities are Foindu Mameima, Bongor, Njama, Majihun, Giema and Diama.

Generally, the six communities report on many common characteristics of how, when and where erosion impact their local facilities. They all state that the natural hazard affects them every year and that it usually takes place during the rainy season, that is, June to October (Appendix E).

In the communities, houses are reported as the most impacted structure, followed by roads, toilet facilities and hand pumps.

In Foindu Mameima, erosion “[...] leads to the sinking of houses [...]” (Appendix F). This likely means that as the foundation of the houses erodes, the houses sink. This phenomenon also occurs in Bongor, as seen in Figure 27 below. Here they cope with the natural hazard by “Constructing houses (...) [at] the other side of the community.” where erosion is less hazardous (Appendix F).

To minimize the effects of erosion and control the large masses of rain-water during heavy downpours, Foindu Mameima and Bongor are also “Digging drainage [systems], to strengthen the foundations.” (Appendix F). While the drainage systems may not directly strengthen the foundation of the houses, they will help direct the water away from the houses and thereby mitigate erosion effects.

The Majihun and the Diama communities are likewise constructing drainage and waterway structures, as well as they are “Putting sandbags to block the [naturally occurring and unwanted] waterways so that any flow of water may not remove the topsoil around our houses.” (Appendix E). Issues with the erosion of the topsoil surrounding the houses, thus exposing the foundations, is evident in the community, where houses are abandoned, as pictured in Figure 28.

In Giema, the community uses sandbags and constructs aprons around the houses to divert the water and mitigate the impacts of erosion, see Figure 29 (Appendix E). Compared to the houses in Bongor and Majihun, it is evident that the aprons do create some support for the houses in Giema.

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Figure 27: Erosion of foundation on house in Bongor (own picture)

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## 6.3 Flooding

On a global scale, floods are registered as the most recurring and widespread weather-related natural disasters. Projections show that floods will continue to increase in intensity and frequency as a direct result of climate change and changes in precipitation patterns (WHO, n.d.-a, NSSL, n.d.).



Figure 28: Abandoned house due to erosion in Majihun (own picture)

Floods occur when water overflows onto normally dry land. Heavy rainfall, rapid snowmelt, and storm surges are the leading causes of floods. Floods carry a long list of devastating social, economic, and environmental consequences and losses, as both lives, personal property, and critical health infrastructure can be at risk by even a few centimetres of flooding (WHO, n.d.-a, NSSL, n.d.).

Floods are registered in the Kenema district every year. Reportedly, mitigation efforts have not lowered the risk of flooding (Morriba, 2019). The climate-related hazard landscape of the Kenema District is especially prone and vulnerable to both river floods and flash floods. (ThinkHazard, n.d.). According to the Hazard and Risk Profile Information System – Sierra Leone (HARPIS-SL), the general flooding risk profile of Kenema is moderate (HARPIS SL, n.d.). Thus, there are some discrepancies in the scientific literature on the risk of flooding within the district.

In the focus group interviews of the present study, five communities, Foindu Mameima, Bongor, Njama, Kongohun and Faama, report different incidents of flooding in their communities.

### Fluvial flooding

According to the open-source data platform ThinkHazards!, provided by the Global Facility for Disaster Reduction and Recovery (GFDRR) and the World Bank Group, river (fluvial) floods are categorised as having a *High*



Figure 29: Aprons in Giema (own picture)

hazard level as projections show that damaging and life-threatening river floods will occur every 10 years within the Kenema District (Think-Hazard, n.d.).

The two communities, Foindu Mameima and Bongor, are impacted by fluvial flooding, which is the inundation of the nearby floodplain. Fluvial floods are mostly caused by heavy downpours (Benito and Hudson, 2010). The communities are highly prone to this type of flooding as they are located in between waters, that is, two rivers are bordering the communities, see Figures 30 and 31. According to the two focus group interviews in Foindu Mameima and the national flooding reports, the community was severely impacted by a river flooding in 2017. The flooding was an outcome of several days of heavy downpour, which made the river exceed its banks (Appendix F; HARPIS-SL, n.d.).

Bongor reports that due to flooding, “[...] alligators do disturb them, killing their dogs and other domestic animals.” (Appendix F), which indicates that when the river overflows, alligators will move closer to the community, thus creating an even more severe hazard.

Fluvial flooding is also affecting the Njama community. Njama is located in the Gola Rainforest, in a valley, surrounded by swamps and close to a river, making the community naturally prone to fluvial flooding. The data received from the Njama community shows that flooding takes place from July to September, which are the peak months of the rainy season (Appendix E; World Bank Group, n.d.).

#### High water table and groundwater flooding

Foindu Mameima and Bongor also struggle with high water tables. This especially affects their well and handpump in Foindu Mameima, where one focus group states: “Because of the increase in high water level, water does move from beneath the earth and then contaminate our water.” (Appendix F). This statement indicates that flooding is not perceived to be caused by weather events but rather a force from beneath the earth. The information retrieved from both communities stipulates that the two communities are likely affected by groundwater floods. This event is often occurring during the rainy season as the high amount of rain often exceeds the amount of water that drains off from the water table (Appendix F; Environment Agency UK, 2019).

Groundwater flooding is an upwards penetration of water from the underground. Groundwater flooding is not connected to fluvial flooding, which in nature often will be of a shorter period than flooding from rising



Figure 30: River in Bongor (own picture).

groundwater. Groundwater flooding is very likely to happen in chalk soil, as chalk is an aquifer. However, it also occurs in gravel and sand soil (Macdonald et al., 2008).

In Foindu Mameima, the community reports difficulties in constructing toilet facilities due to soft soil and high water table. At the time of writing, the community has no functioning toilet facilities. Therefore, the inhabitants find themselves forced to use the bush or the river for defecation purposes (Appendix E and F).

In Bongor, toilet facilities are likewise impacted by the high water table as they tend to overflow and collapse during groundwater floods, see Figure 32. Consequently, the community is without access to toilets for several months every year, and it poses a significant health and hygiene risk for the inhabitants (Appendix F).



Figure 31: River in Foindu Mameima (own picture)

Both soft soil and high water table are likely catalysts of groundwater flooding or at least circumstances that add to the risk of the natural hazard occurring. The community members address this hazard by expressing a deep-felt need for using concrete to strengthen and sustain the toilet structures (Appendix E and F).

In Njama, the majority of the existing toilet facilities are not functional or in poor condition as the high water table is destroying their structures as well. During the rainy season, through the months of August and September, the toilet facilities are impacted, as they “[...] flood up.” (Appendix E) because of the high water table, making them inaccessible.

Kongohun and Faama face many issues similar to the above-described communities, as they are also impacted by fluvial and groundwater flooding.



Figure 32: Collapsed toilet in Bongor (Own photo).

In Kongohun, they report how their toilet facilities are impacted by groundwater flooding; “Because of the texture of the soil it [toilets] is easily destroyed. Due to the water level it [toilets] does fill easily.” (Appendix E). Thereby, the soft soil seems to make the mud and stick structures of the toilet facilities at risk of collapsing. The high water table contributes to the facilities not working or being unsafe from April to September in Kongohun and from July to September in Faama. In these periods, the communities report that the toilets flood, thus making them unfit to use (Appendix E).

#### Exposure to floods and protection from climate change

In both Bongor and Foindu Mameima, the community members express that houses are the most exposed in terms of flooding in the ranking exercises. In Foindu Mameima, the roads, agricultural areas, and hand pumps are impacted by the hazard as well, while members of the Bongor community report that their toilet facilities and waste dump sites

are affected when the community experiences events of flooding. In Njama, the road network is rated as the most exposed element, which corresponds to the recent collapse of two bridges on the main road to the community making the community inaccessible by car (Appendix C).

The participants in Bongor, Njama, and Faama report that their waste dump sites, which are often just an area where waste is deposited, are not fenced thus protected against any types of flooding (Appendix E and F). In Bongor, flooding leads to “[...] *the waste being all over town.*” (Appendix F), meaning that the climate-induced hazard might pose a health and hygiene risk to the community when impacting the waste dump site. Likewise, the community members of Diama report: “*During the raining seasoning the water level is too high. So, it’s [waste dump site] not protected from this hazard.*” (Appendix E).

#### 6.4 Wildfires

Wildfires are unwanted and unplanned fires that burn down natural areas, including forests, savannahs, or grasslands. Both human activities and natural occurrences, e.g., lightning, can lead to wildfires. In half the cases of recorded wildfires, it is not possible to identify how they started. Wildfires are likely to occur during dry seasons or droughts and are exacerbated when heavy winds arise. In many cases, wildfires impact not only humans, animals, and biodiversity but also interfere with transportation systems, power services and water supply. In addition, it destroys property and crops (WHO, n.d.-b).

In Sierra Leone, wildfires are one of the biggest causes of forest destruction and land degradation and are a significant threat to human life (HARPIS SL, n.d.).

In the present study, four out of 10 communities report incidents of wildfires. These communities include Bongor, Ngewahun, Kongohun, and Semewabu. Common for these reports is that a natural hazard is a recurrent event every year. All communities are impacted from March to April, except for Semewabu, which is also impacted in January and February. Based on these reports, it is possible to correlate the time of the dry season, which runs from December to April, to the events of wildfires in these communities (World Bank Group, n.d.). Generally, houses are the most exposed and impacted structures in the four communities after that, agricultural areas (Appendix E).

In Ngewahun, the community is trying to minimize the effects of wildfires by “*Planting trees and ensuring distance between houses.*” (Appendix E). In

Kongohun, community leaders “[...] *tell people to ensure they extinguish their fires.*” (Appendix E) as hazard prevention.

In all 10 communities, fire is a source of life and survival. Food is prepared over a fireplace; some communities burn waste to control the masses; others use fire to cultivate farming areas; and Faama uses fire to clear grassland where venomous snakes might hide, see Figure 33. However, these activities might pose a threat to the safety of the communities, as the fire quickly can turn into a life-threatening force if the activities are not handled carefully (Appendix E and F).

Semewabu is exceptionally impacted by wildfires, as they destroy houses and crops. Bylaws on cleaning standards is a coping strategy used in the community to minimize the risk of wildfires spreading from house to house. According to the community, they have experienced fires spreading through their wastes on the street. Furthermore, a designated



Figure 33: Burning of grass in Faama (own picture).

group of people are responsible to manage fires and make sure they are put down (Appendix E).

In Ngewahun, the community members use water to extinguish the fires, while residents of Kongohun use sand as a fire extinguisher (Appendix E). In Ngewahun, designated groups are responsible for reconstructing the damages from the wildfires when they have been distinguished. A similar strategy is implemented in Kongohun, Bongor and Semewabu, where the community come together to help the exposed people to rebuild their houses (Appendix E).

#### 6.5 Drought

Water scarcity, defined as “[...] *long-term water imbalances, combining low water availability with a level of water demand exceeding the supply capacity of the natural system.*” (The European Commission n.d), is not yet an issue in the Kenema District. However, droughts, being a more temporary decrease in water availability, is likely to happen in the coming years (UNDRR, 2000; ThinkHazard n.d.).

In the present study, Semewabu is the only community reporting water scarcity. According to one of the key informants, the community is experiencing increased cholera outbreaks due to water scarcity. However, the water scarcity is not necessarily caused by drought, as the community members report a broken well (Appendix E).

However, two communities, Foindu Mameima and Njama, state that they are impacted by drought. Both communities report that the hazard affects them every year, and the development of the hazard has become worse in the last decade. According to the community participants, Foindu Mamaima and Njama are experiencing droughts from February to April, which corresponds to the dry season (Appendix E and F). Consequently, the communities are likely not facing a general issue of water scarcity, but rather periodic, short-term droughts caused by a shortfall in precipitation.

Drought is impacting the agricultural areas and activities in the two communities. In Njama, during this period, they “[...] *have to stop the farming activities until it rains again.*” (Appendix E). In Foindu Mameima, they relocate their farming areas and “[...] *move to another place for water.*” (Appendix F). Furthermore, they explain that they “*Dig holes for water, but these are not enough (red).*” (Appendix F). The participants from the Njama community explain that they cope similarly as they “[...] *find a swamp to dig a small hole where we can get water to water the farm.*

” (red).” (Appendix E).

There are no direct quotes from the focus groups, nor the key informant interviews, which show how drought is impacting the WASH facilities in the two communities. However, the male participants in Njama explain that their functional hand pump is not working from February to April, which corresponds to the same period in which they indicate drought is occurring (Appendix E). Very similar information is given by the community participants in Foindu Mameima, as they report that their well and hand pump are not working in March and April (Appendix F).

Based on these findings, it is reasonable to assume that drought is caused by a decrease in precipitation during the dry season, which leads to periods of malfunctioning in the WASH facilities in Njama and Foindu Mameima. The findings also indicate that the functioning of the hand pumps and wells relies on perception patterns, which could suggest that the boreholes within those structures are not deep enough (USGS, 2019). Both communities are also affected by flooding of their wells in the rainy season, which again underlines the possibility that the issue is related to the state of the WASH facilities rather than a lack of accessible water.

#### 6.6 Landslide

Landslide is a general term that covers a wide range of gravitational downslope movements of soil and rock masses. There are many causative factors in play when a landslide occurs. Usually, the mass movement is triggered by unusual quantities of rain, but human interventions and activities such as deforestation and construction on vulnerable hill slopes increase the risk of a landslide event (HARPIS SL, n.d.).

In Sierra Leone, climate change and population growth, including a subsequent demand for infrastructural development and stone mining activities, are the main reasons why previously considered safe hills are now registering landslides. The recorded landslides have caused severe human, socio-economic, and environmental losses, and today landslides are the most critical geological hazard in Sierra Leone. In total, thousands of Sierra Leoneans have been impacted by the hazard during the last decades. The hazard accounts for 42.7% of all geohazards mortalities nationally recorded from 1990 till 2014. Thus, landslides have caused more human casualties than floods, fires, and storms. The most recent and severe landslide disaster took place in Freetown in 2017. More than 500 people were recorded dead, and 50,000 were either directly or indirectly impacted by the hazard (HARPIS SL, n.d.).



Figure 34: Area deforested in Ngewahun (own picture).

However, in the Kenema District, landslides are less likely to occur as the topography is less steep. ThinkHazard! identifies landslides as a low-level hazard within the District of Kenema as “[...] *The area has rainfall patterns, terrain slope, geology, soil, land cover and (potentially) earthquakes that make localized landslides an uncommon hazard phenomenon.*” (Thinkhazard, n.d.).

The forecast by ThinkHazard complies with the data received through the participatory workshops of the present study, as only one of the 10 assessed communities reports landslide events. According to the male community participants in Ngewahun, a landslide took place in 2016 (Appendix E). The landslide heavily affected the agricultural areas of the community. Therefore, their coping strategy was to relocate their farming areas and establish a designated group of people “[...] *to ensure fast farming for the provision of food.*” (Appendix E). To minimize the risk of future landslides the community are “*Undertaking afforestation acti-*

*vities, and [by-]laws are put in place to ensure trees are not cut down.*” (Appendix E).

According to Ibrahim Sannon, the Youth Leader in Ngewahun, “[...] *they [used to] have a lot of forests, but because of farming and timber logging, they do not have much left.*” (Appendix E). Figure 34 shows how a piece of land within the community has been deforested to make room for rice farming.

As mentioned, deforestation can be an aggravating factor of landslides as it causes land degradation (HARPIS SL, n.d.). To some degree, the deforestation taking place in Ngewahun has likely provoked the event of the previous landslide. The fact that the community is located on a hillside also aggravates its vulnerability towards the natural hazard (Appendix E).



Abandoned mining and deforestation site in Diama (own picture)

## 6.7 SUMMARY HOW ARE THE COMMUNITIES IMPACTED BY CLIMATE CHANGE?

**THE ANALYSIS ABOVE CLARIFIES HOW WINDSTORMS, EROSION, FLOODING, WILDFIRES, DROUGHT, AND LANDSLIDES IMPACT THE 10 COMMUNITIES. TABLE 9 PROVIDES A BRIEF OVERVIEW OF THE RISK PROFILES OF THE CLIMATE-INDUCED HAZARDS IN THE INDIVIDUAL COMMUNITIES**

**SCORING AND COLOURING:** THE COLOURS AND SCORING USED TO PRODUCE TABLE 9 INDICATE TO WHAT DEGREE THE COMMUNITIES ARE BEING IMPACTED BY A GIVEN HAZARD. ONE POINT IS GIVEN FOR EACH FOCUS GROUP MENTIONING THE HAZARD. POINTS ARE ALSO DISTRIBUTED BASED ON THE DEVELOPMENT OF THE HAZARD IN THE PAST DECADE, THAT IS, ZERO POINTS FOR BETTER, ONE POINT FOR UNCHANGED, AND TWO POINTS FOR WORSE. ACCORDINGLY, THE MAXIMUM SCORE IS SIX POINTS PER HAZARD, REFLECTING A HIGHLY IMPACTFUL HAZARD. TABLE 9 ILLUSTRATES HOW SCORES AND COLOURS ARE RELATED. THE GREEN COLOUR INDICATES A LOW IMPACT, WHILE ORANGE CORRESPONDS TO A MODERATE IMPACT AND RED TO A HIGH IMPACT. WHITE CELLS REPRESENT IF NO DATA IS RECEIVED OF THE PARTICULAR HAZARD.

Based on the scoring methodology, Majihun followed by Njama and Bongor are the top three countries experiencing climate-induced hazards.

As evident in Table 9 and the analysis, eight out of 10 communities mention windstorms as a hazard that impacts them. Therefore, it is the most prevalent hazard affecting the 10 communities. The location of the communities seems to be one of the fundamental indicators of the impacts of windstorms. The communities located on hills with little forest surrounding them are the most impacted, while communities located in valleys surrounded by forest are the least impacted. Poor construction and the use of climate-sensitive materials are likely the reasons why houses and toilet facilities are the most impacted facilities in terms of windstorms. In general, windstorms have a moderate impact on the eight communities. The only exception is Majihun that are highly affected.

Six out of the 10 communities are experiencing erosion within their communities, making the hazard the second most impactful. Generally, erosion occurs in the rainy season, indicating that the communities deal with water-based erosion. Houses are the most impacted structure, followed by roads, toilet facilities and hand pumps. Many communities are mitigating erosion with the help of sandbags and aprons. Erosion has moderate impacts on the communities except for Majihun, which is highly impacted, and Njama, which are impacted to a small degree.

Flooding impacts five of the communities. It is primarily fluvial flooding and groundwater flooding that the identified communities face. All communities are to some degree located near rivers, some communities are even located between two separate streams. During the rainy season, long term rain or heavy cloudburst, the river naturally exceeds its banks, thus affecting the communities close by. Communities experiencing groundwater flooding face issues of flooded and collapsed toilet facilities due to the rising water tables. In general, housing is the most impacted structure in the communities, while roads and agriculture are close follow-ups. The communities are moderately affected by flooding except for Bongor that is highly impacted.

Wildfires impact four out of the 10 communities. The hazard is primarily occurring in March and April, the last months of the dry season. Houses are the most impacted in the communities, followed by agriculture. Generally, wildfires have a low impact on the communities. Only Semewabu is moderately affected.

## 7. How are human-induced activities aggravating the impacts of climate change?

Drought is an issue in two communities. In both communities, agriculture is the most impacted facility. Drought usually takes place during the dry season, hence it happens due to a decrease in precipitation. Both communities are located near rivers, and therefore the location does not seem to affect if a community experiences drought or not. Drought has a low to moderate impact on the communities.

Only Ngewahun report that the community is experiencing landslides. As the community undertake deforestation activities and is located on a hill, they might experience landslides in the future. However, the community take on afforestation in the impacted area as a mitigation measure. Landslides have a low impact in Ngewahun.

	Windstorms	Erosion	Flooding	Wildfires	Drought	Landslides	Total
Foindu Mameima		1	3		3		7
Bongor		4	5	2			11
Ngewahun	4			1		1	6
Njama	4	3	2		2		11
Kongohun	3		4	2			9
Faama	3		3				6
Majihun	6	6					12
Giema	4	4					8
Diama	4	4					8
Semewabu	4			3			7
<b>Total</b>	<b>32</b>	<b>23</b>	<b>17</b>	<b>8</b>	<b>5</b>	<b>1</b>	
1 point	2 points	3 points	4 points	5 points	6 points		

Table 9: An overview of human-induced hazards

**THE FOLLOWING ANALYSIS EXAMINES WHAT HUMAN-INDUCED ACTIVITIES THE SELECTED COMMUNITIES TAKE PART IN AND HOW THEY AGGRAVATE THE LOCAL IMPACTS OF CLIMATE CHANGE. THE EXAMINATION DRAWS ON SCIENTIFIC LITERATURE, BUT THE EMPHASIS IS ON THE DATA COLLECTED IN THE PARTICIPATORY WORKSHOPS TO ENSURE THAT FINDINGS REPRESENT THE OUTLOOK OF THE INVOLVED COMMUNITIES.**

### 7.1 Deforestation

A wide range of factors, forces and conditions can cause deforestation and land degradation. These include extreme weather conditions such as a drought as well as human-induced activities degrading or polluting the soil (HARPIS SL, n.d.). Even though degradation can happen naturally, it is in many ways aggravated by human-induced activities such as “[...] deforestation, over-cultivation of cropland, overgrazing of rangeland, waterlogging and salinization of irrigated land, and pollution and industrial causes.” (HARPIS SL, n.d.).

Today, forested areas cover approximately 38% of Sierra Leone. However, this figure continues to decrease every year. According to HARPIS SL (n.d.), deforestation usually arise due to underlying factors such as poverty. The main forces driving deforestation in the country is urbanization; cultivating the soil for farming purposes; mining activities as well as timber logging and coal production (HARPIS SL, n.d.). On a national level, findings indicate that Sierra Leone has lost 30% of its tree coverage since 2000, and estimates by Global Forest Watch (2020) shows that the District of Kenema has lost 7.8% of its primary forest since 2002 (Global Forest Watch, 2020).

In the present study, 10 out of 10 communities disclose that deforestation activities encounter every year. Foindu Mameima indicates that the effects of deforestation are impacting them from December to March every year, while Semewabu reports that deforestation is impacting them from September to June. In Bongor, the male focus group interview indicates that the impact of deforestation is taking place from July to September, while the women answer that it takes place “*In the dry seasoning from February to March.*” (Appendix E). Even though these statements contradict each other, the community members agree that the development of the activity has become worse in the last 10 years (Appendix E and F).

The contradictions of the reported period in which deforestation takes

place might be due to the communities being impacted by deforestation in different ways. Some experience an increase in windstorms while other struggles with heat and drought.

### Wind

In Foindu Mameima, the community reports that: “*It [deforestation] leads to too much of a breeze and causes destruction.*” (Appendix F), indicating that deforestation is especially aggravating the impact of windstorms in the community. In both Ngewahun, Njama, Majihun, Foindu Mameima, and Bongor housing is ranked as the most exposed facility towards deforestation, presumably as the participants have linked the human-induced activity to the increase in windstorms of which the respected communities are experiencing (Appendix E and F).

The windstorms arise during the dry season, which correlates with the time of the Harmattan wind (Appendix E). The Harmattan is a north-eastern, cool and dry wind that runs through Sierra Leone in the dry season. The Harmattan originates from the Sahara Desert and brings lower temperatures from November to mid-March where the wind is the strongest (Government of the Republic of Sierra Leone, 2018).

Based on the data retrieved in the present study, it is not possible to determine whether windstorms are increasing in intensity because of climate change, or if windstorms are having a greater impact since deforestation activities destroy the otherwise natural windbreak and thus highly exposes the communities.

### Heat and drought

Heat is mentioned by Geima and Majihun as a consequence of their annual deforestation activities. In Geima, one key informant state that deforestation “[...] leads to increase in temperature due to high rays of the sun.” (Appendix F). According to the town chief of Majihun, cash crops are destroyed due to too intense sun exposure. Sun exposure also creates health issues in the community as the lack of shade from the trees makes living conditions unsafely hot (Appendix E).

In one of the key informant interviews in Majihun, drought is mentioned as an effect of deforestation: “*Due to deforestation we don't have easy access to natural water. We used to dig holes in the forest to get water, but that is not possible anymore.*” (Appendix E).

Drought caused by deforestation is a common issue that is also seen in other rainforest areas such as the Amazon (Bagley et al., 2014). It is pos-

sible that likewise, effects are taking place in the Majihun community. Kongohun, Faama, Geima and Diama indicate that their agricultural areas are the most impacted by deforestation. These communities may also be experiencing some impacts of drought. One key informant in the Semewabu community mentions that their crops have died due to “[...] *the high sun rays.*” (Appendix E), which might indicate that missing shade from trees due to deforestation is causing crop failure (Appendix E). Based on the data retrieved from the communities, deforestation activities may be both causing a higher exposure to the sun and aggravating drought-like effects.

#### Deforestation and livelihoods

The data retrieved from the participatory workshops are inconclusive on why the communities undertake deforestation activities. However, the way their livelihoods are structured may be cultivating the activity. On a general level, the data shows how the livelihood and primary sources of income for the majority of the communities are related to farming activities, especially rice and cocoa farming. The key informant interviews also reveal that other sources of income include diamond and coal mining and timber logging, which are all supported by and dependent on deforestation activities.

Diama is the only community where the participants have reflected upon alternative ways of generating income as a way of minimizing or stopping deforestation activities. They state that deforestation can become more sustainable or less hazardous if community members are *“Given the finances to do other business e.g., creating ways for rearing animals and construction of companies to employ us.”* (Appendix E). Based on this statement, it is fair to assume that deforestation is creating a significant source of income in the involved communities. Thus, it is going to be difficult to restructure the communities unless they are giving alternative ways of living and creating income.

#### 7.2 Mining

Mining is an activity carried out by man to extract valuable materials and substances from the earth. Diamonds, gold, sand, copper, and iron are some of the most common resources which are mined around the globe for human use (National Geographic Society, 2020). In many ways, mining processes can be very harmful to both humans, ecosystems, and biodiversity. Examples include acid mine drainage, a type of water pollution, deforestation, and disposal of toxic waste into the environment (National Geographic Society, 2020).

Sierra Leone is rich in minerals such as gold, iron ore, coal, diamonds, and sand. Since the country gained its independence in 1961, mining activities have significantly contributed to the national economy, making the government highly dependent on the extraction of the different minerals. In 2018, 3% of all employment in Sierra Leone was within mining activities; 0.7% of the GDP was established by mining activities; and mining activities stood for 65% of Sierra Leone’s income from export (International Trade Administration, 2021).

The Kenema District is the centre for many diamond and gold mining businesses. Sand mining is likewise becoming a rising problem in the area as the activity is undertaken around the banks of the Moa River, causing an increased risk of riverbank erosion, loss of biodiversity and riverbank collapse (Rogers, 2020; Kamara, 2021).

Mining activities are predominant in the communities assessed in the present study as half of the communities report mining as an activity taking place within their community. These communities include Foindu Mameima, Bongor, Majihun, Diama, and Semewabu. Although the communities agree that they are impacted by the mining activities annually, they report on the activity taking place during different periods. In Bongor and Semewabu, mining occurs from January to December, thus the entire year, while Majihun experiences it from December to May, Diama from March to April and Foindu Mameima from January to August (Appendix E and F).

The development of mining activities is also very dependent on the individual communities. Foindu Mameima states that they are undertaking fewer mining activities than 10 years ago, where mining “[...] *was used for some developmental activities like building structures and construction of wells.*” (Appendix F). The four other communities report that mining has become worse in the last decade.

Housing, roads, agriculture, and the river are mentioned as facilities most exposed to human-induced activity. In Bongor, mining activities “[...] *result in flooding [...]*” why they suggest *“To absolutely forget about digging for diamonds and also if someone comes to dig we should not allow the person. We should minimize mining activities to avoid flooding.”* (Appendix F). The mentality present in this statement recurs in the remaining communities. The participants from Diama “[...] *want to minimize the mining activities.*” (Appendix E) to make the impacts of mining less hazardous, while Semewabu believes they need to *“Leave the work of [mining] diamonds to undertake farming activities instead.”* (Appendix E).

According to the male participants in Semewabu, agriculture is the most impacted, which could be due to the pollution that mining activities cause or the immense land use demand of undertaking mining activities. However, the participants also mention that the men are the most impacted population group within the community as they are the one’s performing the mining activity. Thus, it is possible that farming and agriculture suffer as the result of the labour force of farming is converting to mining (Appendix E). On the other hand, the women in the Semewabu community report that abandoned mining pits are the most hazardous part of the activity as children have fallen into them and lost their lives, see Figure 35 (Appendix E). The people of Majihun are also aware of the problems of abandoned mining sites and would like to mend non-active pit holes, as well as they want to bank the river, which is affected by the activity (Appendix E).

Foindu Mameima also wants to get more *“involved in agricultural activities, supporting our children to be educated.”* (Appendix F). The community do not believe that mining activities are supporting their children as they have experienced how the children tend to have a larger interest in earning money instead of going to school: “[...] *they are no longer interested in learning/no more interest in education.*” (Appendix F).



Figure 35: Abandoned mining pit in Semewabu (own picture)

### 7.3 Waste disposal

Waste management and disposal are terms that cover the gathering, transporting, processing, and disposal of wastes. Waste management includes many different elements as there are various methods and handling processes depending on the type of waste, such as hazardous, chemical, or organic materials (SafeOpedia, 2018).

Sierra Leone has substantial challenges regarding managing waste. Waste management has poor structures, and it is habitual to dump waste into waterways or unmanaged dumpsites. As a result, the poor waste management in the country poses considerable risks to water, sanitation, and hygiene facilities. Future projections show that waste generation is expected to grow due to urbanisation, industrialisation, and the modernisation of the agricultural sector in Sierra Leone. The capital Freetown along with other big cities, such as Kenema, Bo and Makeni are expected to be most affected by risks created by poor waste management structures (HARPIS SL, n.d.).

Though waste disposal and proper management is a prominent issue in the urban parts of Sierra Leone, only one of the 10 communities, Kongohun, identifies the activity as having an impact on their local community in the present study. According to the participants, poor waste disposal and management are taking place throughout the entire year, every year. In the last decade, there have been no changes in development regarding the activity, meaning it has neither become worse nor better. During the focus group interview, it became clear that waste disposal often was made directly in the river as they have no other structures supporting how to get rid of any kinds of waste. As stated by the participants in the male focus group interview, the activity of waste disposal could become more sustainable within the community if there was to be constructed a "Place for disposing of waste." (Appendix E).

Even though Semewabu is the only community reporting on Waste disposal as a human-induced activity negatively impacting their community, other communities mention waste dump sites as a WASH facility that is not functioning rightly. As was mentioned in chapter 4.4 on flooding, many waste dump sites are not fenced, which causes issues with the performance of the facilities in the wet season. In Njama, the community mentions that "The fence is destroyed by the wild animals in the community." (Appendix E). This statement indicates that the community is not only exposed to risks concerning waste management due to climate-induced hazards like flooding and windstorms, but they are also experiencing risks in connection to unwanted wildlife being attracted to the unprotected waste dump site.

In Geima, the waste dumpsite is located on the outskirts of the community, on top of a hill as seen in Figure 36. Whenever the community wishes to 'clear' the site, they would push it over the side of the hill and into their rice-farming areas lying on the bottom of the slope (Appendix E). In Kongohun, they mention that "They push the waste dump site far away." (Appendix E), and several communities indicate that they have trouble with waste management, such as Ngewahun, where participants state that waste "[...] is scattered and difficult to be gathered." (Appendix E). It is not clear how this impacts the communities in detail. Only Majihun indicates that they have an issue with the smell of the waste, which makes it difficult for them to manage it. In Diama, their waste site that tends to flood during the rainy season, and as it "Is also meant for people to defecate." (Appendix E) it poses a severe health threat.

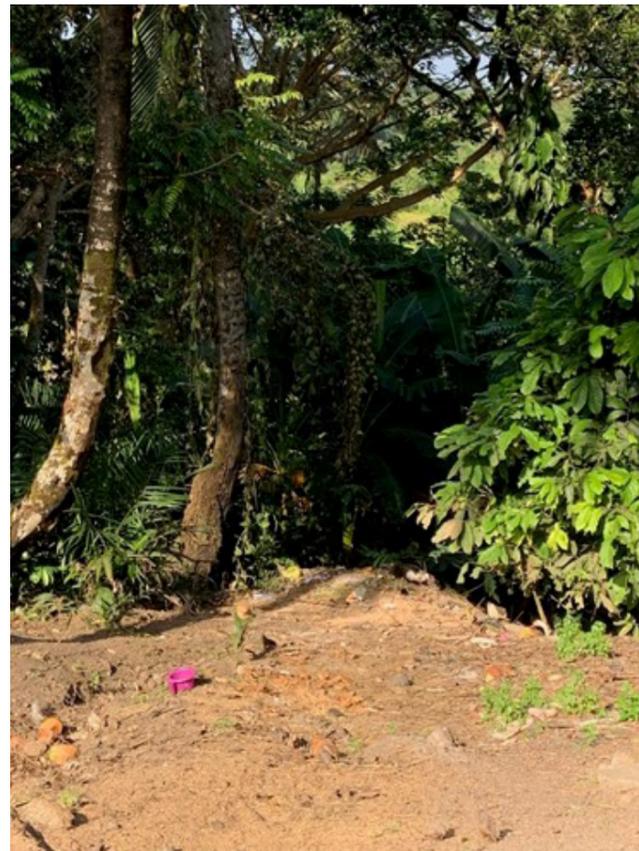


Figure 36: Waste Dump Site in Geima (own picture).

It is difficult to analyse why it is only Semewabu that reports on waste disposal as a human-induced activity negatively impacting the community. It might be due to the methodological approach in terms of how the questions could have been interpreted by the remaining participants. On the other hand, it is also possible that the participants from the remaining communities do not connect poor waste disposal with any experienced hazard. Nevertheless, while the communities do not mention waste disposal as a hazardous activity, it is clear from the above statements that they are impacted by the state of their waste dump sites and difficulties in managing their wastes.

### 7.4 Water pollution

Water pollution is often defined as the issue of letting hazardous substances into water bodies such as subsurface groundwater, lakes, seas, rivers, or streams to such a degree that the released substances negatively affect the water bodies and ecosystems (Nathanson, 2021).

Sierra Leone faces pronounced problems regarding the pollution of drinking water. Almost half of the Sierra Leonean population does not have access to safe drinking water, and only 13% has access to improved non-shared sanitation facilities. In rural areas, only 35% of the inhabitants have access to safe drinking water (HARPIS SL, n.d.). Causes of water pollution in Sierra Leone are amongst others sewage efflux and surface run-offs into boreholes, streams, and rivers (INTEGEMS 2017).

Nonetheless, only Semewabu reports on problems regarding water pollution of the 10 investigated communities. According to the male focus group interview, the river is mostly impacted by water pollution, which affects them from December to April every year (Appendix E). However, it is unclear which kind of pollution is taking place at the river as the data from the interview on this matter is inconclusive. It may be due to waste disposal in the river. In Semewabu, they do not seem to be retrieving their drinking water from the river as they both use rain harvesting, dig holes to retrieve groundwater and have functioning water facilities (Appendix E). While the river is the most impacted, Semewabu also indicates that they have issues with one of their hand pumps, as it is releasing a strange colour, taste, and odour (Appendix E).

While not mentioning water pollution as an activity, Njama likewise states that "Pump was flooded and water from flooding contaminated their drinking water." (Appendix E), indicating that they are experiencing pollution of their drinking water. During the wet season, they are experiencing strange colouration of the water and both taste and smell change

for the worse (Appendix E). However, it is not possible to determine if water pollution is aggravated by human-induced activities such as chemical usage in mining.



Abandoned toilet in Bongor (own picture)

## 7.5 SUMMARY

# HOW ARE HUMAN-INDUCED ACTIVITIES AGGRAVATING THE IMPACTS OF CLIMATE CHANGE?

THE ABOVE ANALYSIS PROVIDES INSIGHT INTO HOW DEFORESTATION, MINING, WASTE DISPOSAL, AND WATER POLLUTION IMPACT THE 10 COMMUNITIES. THE ANALYSIS LINKS HUMAN-INDUCED ACTIVITIES TO CLIMATE CHANGE IN TERMS OF HOW THEY ARE AGGRAVATING THE IMPACTS OF THE IDENTIFIED CLIMATE CHANGE HAZARDS.

Table 10 contains a brief overview of the communities and the respective human-induced activities. Based on the scoring methodology, Semewabu, followed by Bongor and Majihun, are the top three communities experiencing climate change impacts aggravated by human-induced activities.

As stated previously, deforestation practices occur in all 10 analysed communities making the activity the most frequent in the present study. The impact of deforestation in the communities ranges from moderate to high, as shown in Table 10. Deforestation aggravates climate change in several ways as forests, bushes and trees compose a nature-based windshield, provide shade and a root system that holds on to the soil and allows water to easily permeate it. When areas are deforested these climate-resilient attributes vanish, making the identified communities more vulnerable to windstorms, heat, drought, erosion, and flooding. Reasons for the communities to engage in deforestation activities are various. Some communities cut down trees to cultivate new agricultural areas while others take part in timber logging or coal and diamond mining, entailing that land must be cleared to make way for the mining sites.

Five out of 10 communities take part in mining activities. As a human-induced activity, mining impact the identified communities from a low to a high degree. Mining activities exacerbate the impacts of climate change by being one of the primary reasons for deforestation, thus contributing to the above-mentioned climate-related hazards. Lastly, mining activities are also correlated to water pollution as chemicals are often used in the extraction of raw minerals. Thus, the already vulnerable water points

in the communities are at even greater risk of being contaminated and unsafe for drinking purposes.

Only one community, Semewabu, is impacted by human-induced water pollution. Water pollution is impacting the community to a moderate degree. However, the data is inconclusive of how man is contributing to the pollution of the community. Likely causes include poor waste management, lack of toilet facilities, and river contamination by washing and cleaning activities, chemical spills from nearby mining sites, or waste dumping into the river.

Kongohun is the only community affected by poor waste disposal and management. Poor waste management is impacting the community to a low degree. Inefficient or non-existing waste management exacerbates the impacts of flooding and windstorms as waste is easily scattered around the communities if the waste dump sites are not adequately protected, e.g. by being fenced.

	Deforestation	Waste Disposal	Mining	Water pollution	Total
Foindu Mameima	3		2		5
Bongor	6		5		11
Ngewahun	3				3
Njama	5				5
Kongohun	6	2			8
Faama	3				3
Majihun	5		4		11
Giema	6				6
Diama	6		3		9
Semewabu	3		6	3	12
<b>Total</b>	<b>46</b>	<b>2</b>	<b>20</b>	<b>3</b>	
1 point	2 points	3 points	4 points	5 points	6 points

Table 10: Overview of human-induced activities



Toilets in Faama (own picture)

## 8. BRIEF OVERVIEW

# HOW ARE THE WASH FACILITIES EXPOSED?

TABLE 11 ENCOMPASSES A BRIEF OUTLINE OF WHAT WASH FACILITIES IN THE INDIVIDUAL COMMUNITIES ARE THE MOST IMPACTED BY EITHER THE IDENTIFIED CLIMATE-INDUCED HAZARDS OR HUMAN-INDUCED, AGGRAVATING ACTIVITIES. ESSENTIALLY, TOILET FACILITIES ARE THE MOST VULNERABLE OF THE LISTED WASH FACILITIES, SUBSEQUENTLY THE HAND PUMPS AND WASTE DUMP SITES.

SCORING AND COLOURING: THE COLOURS AND SCORING INDICATE TO WHAT DEGREE CLIMATE-RELATED HAZARDS OR AGGRAVATING ACTIVITIES IMPACT THE FACILITIES. ONE POINT IS GIVEN FOR EACH FOCUS GROUP MENTIONING IF THE FACILITY IS IMPACTED BY A GIVEN HAZARD OR AGGRAVATING ACTIVITY. POINTS ARE ALSO DISTRIBUTED BASED ON WHETHER THE FACILITY IS IN GOOD OR BAD CONDITION: ZERO POINTS IF THE FACILITY IS IN GOOD CONDITION AND 1 POINT IF IT IS IN POOR CONDITION. FURTHERMORE, ZERO, ONE, AND TWO POINTS ARE RESPECTIVELY GIVEN IF THE DEVELOPMENT IN THE FUNCTIONING OF THE FACILITY HAS BECOME BETTER, UNCHANGED, OR WORSE IN THE LAST DECADE. CONSEQUENTLY, THE MAXIMUM SCORE IS EIGHT POINTS (FOUR PR. FOCUS GROUP) PER HAZARD.

	Waste Dump Sites	Toilet Facilities	Wells	Hand pump	Water Storage	Total
Foindu Mameima		4	6	4	4	18
Bongor	5	6	5	2	1	19
Ngewahun	2	5		5		12
Njama	3	6		5		14
Kongohun	3	6		6		19
Faama	0	5	4	5	2	16
Majihun	4	5		2	0	11
Giema	4	4		2	0	10
Diama	4	5		4		13
Semewabu	0	5	2	5		12
<b>Total</b>	<b>25</b>	<b>51</b>	<b>17</b>	<b>40</b>	<b>7</b>	
0 points		3 points		6 points		
1 point		4 points		7 points		
2 points		5 points		8 points		

Table 11: Overview of impacted WASH facilities

## 9. How can the communities adapt to the local impacts of climate change?

THE PREVIOUS TWO ANALYSES SHED LIGHT ON HOW CLIMATE CHANGE IMPACTS THE 10 RURAL COMMUNITIES. ALSO, THE ANALYSES SHOW A CLEAR CORRELATION BETWEEN THE ANALYSED CLIMATE-INDUCED HAZARDS AND HUMAN-INDUCED ACTIVITIES; THE ACTIVITIES AGGRAVATE THE LOCAL IMPACTS OF CLIMATE CHANGE. THIS FINDING MAKES IT A COMPLEX TASK OF DEVELOPING ADAPTATION STRATEGIES AS LIVELIHOODS AND INCOME IN THE COMMUNITIES OFTEN ARE BASED UPON THESE ACTIVITIES. THE FOLLOWING SECTIONS BUILD UPON THE PREVIOUS ANALYSES BY DISCUSSING HOW THE COMMUNITIES CAN ADAPT TO THE LOCAL IMPACTS OF CLIMATE CHANGE AND WHAT BARRIERS STRATEGIC, ADAPTATIONAL PLANNING IS FACING IN SIERRA LEONE.

### 9.1 Technical measures: How can grey, technical solutions help improve the adaptational capacities of the communities?

According to the involved communities, technological improvements, better technical knowledge, and provision of maintenance tools and climate-robust materials (grey solutions) are crucial to strengthening the existing structures of the WASH facilities. Toilet facilities, handpumps and waste dump sites are the most exposed facilities, why it is vital to address how these can be reinforced to withstand shocks caused by climate-induced hazards.

#### Toilet facilities

In those communities where toilet facilities are moderately impacted, the technical improvements do not have to be extensive. In Ngewahun, the participants state that they need "[...] help to roof the unroofed toilets." (Appendix E) while Faama declares a need for the "Provision of doors." (Appendix E).

On the other hand, Bongor, Foindu Mameima, and Njama report that toilet facilities are close to non-existing why technical improvements will enclose the construction of new toilets and pits. The community participants in Njama says: "Due to the high water table, those toilets should have a concrete [slab] built in it to ensure its lasting period." (Appendix E). However, Njama is not the only community raising awareness of the existing climate-sensitive constructed toilets. Faama, Kongohun, Giema, Diama, Semewabu, and Majihun express a need for concrete and zinc materials to build or strengthen new or existing toilet facilities. In Faama, a focus group express a "Need for zinc and slabs using concrete and technical knowledge in making these slabs." (Appendix E).

In the eyes of the communities, climate-robust materials as concrete and zinc are possible grey, technical measures to strengthen the toilet facilities and adapt them to present and future climate change hazards and impacts (Appendix E and F).

#### Hand pumps

In terms of hand pumps, the communities most commonly report a need for spare parts to repair broken-down facilities. In terms of climate change impacts, in this regard flooding, Ngewahun expresses a need for fencing their unprotected handpumps, the same goes for Giema and Bongor, while Faama and Ngewahun are stating that they need chemicals to purify the drinking water when or if it gets contaminated (Appendix E and F). The majority of the communities declare that they need financial assistance to repair or strengthen the existing structures of the hand pumps.

#### Waste dump sites

Eight out of the nine communities with waste dump sites impacted climate-induced hazards state that the facility needs fencing to overcome the effects. Other solutions count relocation of sites and the burning of wastes. (Appendix E and F).

Essentially, the technical adaptation measures are low-hanging fruits in terms of solutions that tend to rebuild, repair, or build new structures. However, the grey improvements are not addressing issues towards restoring or rebuilding the protective systems of the surrounding nature and environment. Thus, technical enhancements and measures cannot stand alone when discussing possible solutions for the communities to enhance their capacities to overcome climate change. Consequently, it is adjacent to consider how nature can play an essential role in achieving this objective.

### 9.2 Nature-based solutions: How can nature play an essential role in strengthening the adaptive capacities of the communities?

Within the profession of climate change adaption and green urban recovery, there's a consensus that nature, ecosystems, biodiversity, and nature-based solutions play an essential role in adapting societies to climate change on a global scale (Depietri & McPhearson, 2017). However, ecosystem services and "[...] ecosystems approaches remain the most disregarded component of plans and strategies." (Depietri & McPhearson, 2017, p. 99). In rural settings, green and blue approaches are likewise often overlooked or down prioritised for the benefits of technical and grey measures as these fall under conventional practices of climate change adaptation. Fortunately, findings indicate that the traditional paradigm

of grey solutions is slowly shifting as more and more extensive research suggest that “[...] *well-managed ecosystems and their regulating services can contribute to the reduction of risk and are very often cost-effective, multifunctional and win-win solutions, especially in the long run.*” (Depietri & McPhearson, 2017, p. 100).

As stated in the analyses, human-induced activities, such as deforestation and mining, demolish forests and vegetation that otherwise function as natural windbreaks and preventative control components of land erosion and flooding. Thus, it is necessary to restore and rebuild the protective capacities of nature if it has to play a crucial role in adapting the local communities to present and future climate-induced hazards and variabilities.

Luckily, the communities in the present study show both interest and insight in working with nature-based solutions. In those communities where livelihoods are based upon deforestation and mining activities, the community members explain how afforestation activities can amend and mend damages to the previously forested areas (Appendix F and B). Therefore, planting trees is a pronounced nature-based solution relevant in the communities impacted by intensified windstorms, increased temperatures, more frequent floods, and worsened events of soil erosion.

As stated above, the benefits of working with and implementing nature-based solutions are diverse. Planting trees in the catchment areas of the impacted communities contribute to protecting the communities from future climate change impacts by working as a significant buffer by increasing the communities’ abilities to absorb water, slow down surface water run-off, decrease water pollution. By undertaking afforestation activities, communities are likewise able to restore biodiversity. Furthermore, if the new trees are cash crops, e.g. mango, papaya or coconut trees, a new source of income will be generated every year, which might compensate for the lost livelihoods of stopping mining and deforestation activities.

However, it might be easier said than done to stop the communities from undertaking aggravating activities, as many community members are dependent on the income generated from the activities. Social, political, and economic incentives and restructuring are needed to support the actions of implementing extensive nature-based and grey technical solutions, as the sustainability of the implementations reaches across different disciplines and sectors.

### **9.3 Social reconstructions: How can restructuring of social and behavioural practices support the implementation of technical and nature-based adaptation measures?**

The technical and nature-based solutions do not address the possible need for people to change behaviour or practices in their everyday lives. Hence, the strategic climate adaptation plans must include social and behavioural aspects to support implemented measures.

As touched upon several times, most livelihoods in the communities are based on aggravating activities. In other words, the communities are actively increasing their vulnerability to climate change, and if the activities do not come to an end, they will continue to antagonise the capabilities of the communities to withstand events of climate-induced hazards. Correspondently, the communities need to create new sources of income and change the perception of some social structures and activities.

According to the involved communities, social measures for improving the WASH facilities include forming designated groups to control, maintain and repair the given facilities. In this way, the communities create some organisational capacities they can draw on when a climate-related hazard happens. Although this restructuring shows some advancement in a handful of the communities, it is often not enough when dealing with deep-rooted behavioural practices such as deforestation, mining and poor waste management. In these cases, stricter measures might be necessary to ensure the effectiveness of the adaptational efforts.

Examples of such social measures are the outlawing of deforestation and mining activities or obligatory waste handling within the community. In that case, the communities can design and implement so-called by-laws that essentially are rules or laws established *by* the community to *regulate* the community (Appendix E and F).

By-laws are implemented in Faama, which struggles with flooding and houses being destroyed by water, why “*Laws are put in place for people not to build in those areas where this incident [flooding] do occur.*” (Appendix E).

In Semewabu and Giema, the communities have established by-laws addressing their issues of poor waste management. In Giema, “*Laws are implemented to watch around the waste dump site to.*” (Appendix E), while community members in Semewabu are not allowed to deliberately “[...]

*drop any waste around the community.*” otherwise they face a fine (Appendix E). Several communities, including Faama, Giema and Kongohun, have implemented by-laws hindering deforestation making it socially unacceptable to take part in such activities (Appendix E). These by-laws entail that the community members rethink their behaviours to support the identified adaptation measures.

On the other hand, the by-laws do not put forward alternative ways of securing an income if deforestation, as an example, is banned. Then the risk of the communities not following the laws is high. Behavioural change is all about providing easy and cheap solutions, why it is not enough to ban specific activities or strict another. The communities should consider how to enforce and promote by-laws in a socially sustainable way. In the present study, many communities do not focus on this. As a result, they report on different levels of success in their by-laws.

Also, these by-laws are only active within the given community, meaning other communities might not have the same restriction. Consequently, a neighbouring community might undertake deforestation activities where one community has outlawed the activity. Thus, the forest is not protected or rebuilt at all. This quandary shows a general environmental problem in Sierra Leone: there is no coherent or uphold a ban on deforestation on a national level. In general, there is a need for coordinated efforts across communities, sectors, and governmental bodies if the rural communities in Sierra Leone are to adapt to climate change effectively.

### **9.4 Political streamlining: How are political barriers hindering the implementation of adaptation strategies in rural development in Sierra Leone?**

There are several political restraints when discussing political barriers in the strategic planning of adaptation measures in Sierra Leone. As touched upon early, there is a high demand for political enforcement of forest protection, as local by-laws are not strong enough to address deforestation in areas where more than one community is operating.

On a national level, there is a lack of political focus on climate change adaptation. There is little alignment in the few existing strategies, and no current or future plans addressing the exposed settings of rural communities.

The most recent Nation Adaptation Programme of Action (NAPA) is dated to 2007 and does not merely grasp the recent year’s development in re-

gards to climate change. The proposed solutions are very unspecific and difficult to act upon. As an example, the key statement in regards to Human Health is “*Be healthy, live in a safe environment. Use clean and safe water.*” (Government of Sierra Leone, 2020). There are no further explanations of how to ensure clean and safe water nor how to develop a healthy and safe environment. More concerning is the lack of focus on rural settings, as the complex situation of adapting rural communities are not present in the national plan (Government of Sierra Leone, 2007).

On the bright side, it seems that the government of Sierra Leone is trying to work on the issue as they recently “[...] *formulated a series of increasingly ambitious policy plans on climate change adaptation [...]*” (Government of Sierra Leone, 2020, p. 3) which are being compressed into a new NAPA (Government of Sierra Leone, 2020).

The existing NAPA does not address how different stakeholders, such as governmental and institutional, constitutional, non-governmental and local entities, should coordinate their responses concerning climate change adaptation (Government of Sierra Leone, 2007). Herewith, many different stakeholders work in their individual silos with little or no cross-sectoral collaborations. In that respect, there is a clear need to streamline efforts and goals within the country to address the present and future impacts of climate change.

Fortunately, the United Nations Environmental Programme (UNEP) and United Nations Development Programme (UNDP) report on collaborations with the government of Sierra Leone to mainstream the adaptational plans and solutions within the country (UNDP, 2020). Thus, it seems as if the government are aware of the importance of working across sectors and institutions to design and implement solutions on complex issues such as adaptation to climate change in rural communities.

Nevertheless, the adaptational capacities at national and local levels are at a standstill in Sierra Leone, which means there is a deepfelt need to intensify the decision-making and actions taken by the government to avoid severe impacts of climate change and destructions of crucial infrastructures.

The insufficiency of governmental actions is also present when discussing economic incentives needed to support the development and implementation of adaptation strategies. In Sierra Leone, there’s a general issue regarding the funding and financing of such measures.

## 10. Lessons Learned

### 9.5 Economic incentives: Who is responsible for financing and implementing adaptation measures in rural communities in Sierra Leone?

In most cases, the development, coordination, and implementation of adaptation measures require financial investments. In Sierra Leone where funding structures are weak, a complex discussion within climate change adaptation is in regard to who is responsible to supply economic support for these adaptational initiatives.

Even though it has been 20 years since the destructive civil war ended, the county continues to suffer massively from weak political structures and institutional capacity. The country struggles with high rates of corruption and economic inequality (Chêne, 2010). The lack of capacity and the significant gaps in inequality result in tensions and misbeliefs, and the governing body is, by some, perceived as an untrustworthy institution. Likewise, there is a lack of political responsibility when discussing climate change adaptation which puts an enormous burden on other stakeholders such as national and international NGOs.

Sierra Leone is a land of milk and honey for NGOs that wish to implement development initiatives. As of now, NGOs and international institutions, such as the European Union (EU) and the United Nations (UN), support much of the adaptational development within the country. Thus, these stakeholders play an essential financial role in securing adaptational capacities.

As the interest of most NGOs is to improve livelihoods, the rural areas of Sierra Leone are often welcoming and appreciating the initiatives. However, the many different stakeholders and their individual agendas and donor responsibilities complicate the streamlining of national adaptation strategies, as discussed in the previous section.

Also, it is essential to bear in mind that even though NGOs are often working in favour of the local communities, they are in the end business with responsibilities for investors, donors and employees to produce some form of revenue. Thus, it is not necessarily sustainable that NGOs are providing economic support and continue to take the lead and responsibility of developing the country.

On the other hand, Sierra Leone is not in a state where they are ready to rely less on international stakeholders and NGOs, as they are not financially or institutionally capable of easing the stress on these stakeholders. To realise this, a series of issues ranging from corruption to stabilising

the national economy needs to be solved, which entails a long, though, and costly transition of strengthening the governmental structures.

The remaining question is then, *how do we ensure the long-term sustainability of adaptation measures in rural settings in Sierra Leone?*

**THE PREVIOUS DISCUSSION SHEDS LIGHT ON THE MULTIFACETED COMPLICITY OF ADAPTING TO CLIMATE CHANGE IN RURAL SETTINGS. THE FOLLOWING SECTIONS AIM TO ROUND OFF THE STUDY BY REFLECTING UPON MAJOR LESSONS LEARNED TAKING DEPARTURE IN THE PROBLEM OF HOW TO ENSURE THE SUSTAINABILITY OF ADAPTATION MEASURES AND INITIATIVES. LASTLY, THE SECTION REVIEWS HOW THE METHODOLOGY INFLUENCES THE FINDINGS AND SHOWCASE THE STRONG AND WEAK SIDES OF WORKING PARTICIPATORY IN RESEARCH CONTEXTS.**

### 9.1 Ensuring the long-term sustainability of adaptation measures and initiatives

Even when adaptation strategies address technical, social, political, and economic components, they still need the support of the local community to become successful. Community support is essential for the sustainability of many initiatives, especially when working with rural communities like the ones assessed in the present study.

Within the Kenema District, there are plenty of examples of unsuccessful initiatives. Abandoned and neglected WASH facilities is not a rare sight in the District. Facilities of critical importance decay even in the most rural parts of Kenema. The most common example is organisations that drill wells and construct handpumps to increase access to water but leave without providing proper training or knowledge on how to maintain and take care of the new WASH facilities. The abandoned WASH facilities stand as living evidence of how unfruitful it is to implement new initiatives without involving the civil society, that is, the communities. Even if the best intentions of the initiatives are to help the local communities, it is neither respectable nor sustainable to exclude the beneficiary communities when implementing measures.

Observations from the field study and the data collection workshops show huge issues with especially the maintenance of WASH facilities and other key structures. Thus, sustainability often equals long-term management of facilities.

In the eyes of Engineers without Borders Denmark, sustainability equals technical capacity building of the local communities and partner organisations. Therefore, their initiatives often include training and knowledge sharing on the technical parts of maintaining and taking care of WASH facilities. Advocacy and raising awareness of the structural or global is-

ues, such as climate change, are likewise sustainability strategies undertaken by the NGO.

In the initiative where the present study takes part, EWB-DK plans to conduct technical training sessions of designated groups in each community in the coming year. As previously discussed, ensuring sustainability through practical training and capacity building of the impacted communities is a traditional approach taken by several NGOs working with WASH in the Kenema District.

However, it is beginning to show that training and capacity building is not enough to ensure the sustainability of WASH facilities in rural areas in the District of Kenema. In the district, the so-called WASH Committee discusses issues regarding WASH and sustainability every month. The Committee holds leading members and stakeholders working in the field of WASH, including the Water Directorate, City Council, the Environmental Protection Agency, Red Cross, Medicine sans Frontières, World Hunger Hilfe, and SEND SL. Nevertheless, it still seems to be a mystery for these key stakeholders how to ensure sustainability in practice.

All parties agree that the local communities must endow the given measure before the implementation starts. To do so, the communities need to feel ownership and responsibility. Likewise, they must be engaged in the many processes of assessing issues and implementing solutions. Otherwise, there is a high risk that the initiative falls flat.

For instance, SEND SL reports on incidents on how the trained group of community people move to other communities to earn money on their newly learned technical skills instead of taking on their responsibility of maintaining facilities in their own community. Consequently, SEND SL is trying to address the problem of ensuring sustainability in a more structural way instead.

While still building capacity in the communities through advocacy and raising awareness of local climate change impacts and how the individual communities can adapt, the organisation also focuses on how the community can come together to ensure sustainability as one entity. In this regard, this entails standing together economically through small funding structures in the community.

Thus, whenever WASH facilities break down, due to climate-induced hazards or not, there are few economic buffers within the communities to

# 11. Conclusion

create a response. Accordingly, it leads to the disrepair of many facilities as no one is responsible for either paying or maintaining the facilities. But nudging the community people to allocate a small amount of their income for the greater good of the entire community make them able to maintain and fix facilities in a more uncomplicated manner. Likewise, the communities become less dependent on a designated trained group as they instead can pay a technician from the city. This sustainability model is gaining a foothold in more and more development initiatives in the Kenema District, as initiatives established by SEND SL showcase substantial successes.

## 10.2 Methodological reflections: Subjectivity and bias

Using participatory approaches in collecting data have contributed to raising awareness of climate change impacts in the local communities. However, when using participatory principles, several factors influence the end findings. The following section seeks to reflect upon the level of bias and subjectivity and how these are evident in the present study. No matter how scientific a method is, it is impossible to conduct fully objective research. The researcher's assumptions, perceptions, and experiences will always influence the structure of the study and the posed problems in question. As a result, the study needs to address, identify, and acknowledge possible assumptions that might influence the findings to increase transparency and minimise biases. Thus, all research must reflect on its empirical data and methods before and when concluding (Gosling & Edwards, 2003).

One major critique on Participatory Research and Participatory Learning and Action (PLA) centres on biases and the lack of objectivity. Thus, it is particularly vital to address how the present study minimises unwanted bias and ensures an equitable level of objectivity (Fischer, 2000).

The present study has had an enormous focus on the importance that participants of the data collection workshops did not force untruthful answers if they believed they would benefit the study or themselves. It was fundamental that the researchers created a non-judgmental and safe environment for the participants to share honest and unbiased thoughts, knowledge, and ideas (Gosling & Edwards, 2003).

Following the guidelines posed by Gosling and Edwards (2003), the present study minimised bias by activating workshop facilitators (students) with different viewpoints, backgrounds, gender, experiences, and skills when gathering data and information of each local community.

The pre-developed questionnaire helped the facilitators to moderate the focus group discussions. Thoughts and efforts have been made to the phrasing of each question to ensure they were neutral and not assuming or favouring any specific answers. Furthermore, the facilitators undertook several training sessions in the data collection methods that emphasised being impartial, welcoming, and non-judgmental. In essence, the facilitators learned to allow and respect all forms of answers even if they disagreed with them themselves.

The training sessions contained roleplay, discussions, and Q&As. Before going to the selected 10 communities, the facilitators conducted a pre-test in a nearby community to assure they felt confident in the method and the questions for the focus group discussions. To ensure that community participants felt comfortable responding to answers on private matters, such as where one might go to the bathroom, the workshops were divided into gender-specific groups. The facilitators were then assigned to their gender group, encouraging especially the women to speak their minds.

It is essential to underline that the information retrieved from the participatory data collection workshops reflects subjective stances of the community members, and in terms of the present study, this is not an accident. The study wishes to investigate the level of knowledge on climate change and how the *local communities* are *experiencing* climate change impacts within their communities. Thus, the study aims to address the issues expressed by the communities and not the one's only presented in the scientific literature or external experts. As evident in the analysis, the literature on climate change impacts in Sierra Leone and the expressed local impacts expressed by the communities are often far from being in concordance. To strengthen the communities in the best way possible in terms of helping them overcome future shocks of climate-induced hazards, the initiative by EWB-DK and SEND SL has great faith in the local communities, thus future measures will be based upon the issues stated by the individual communities.

**SIERRA LEONE FACES PROFOUND ISSUES OF POVERTY, CORRUPTION, LOW INSTITUTIONAL CAPACITY, AND POLITICAL INSTABILITY. THIS MULTIDIMENSIONAL FRAGILITY COUPLED WITH THE COUNTRY'S EXISTING CHALLENGES OF ADDRESSING CLIMATE CHANGE RISKS, IN TERMS OF RISING TEMPERATURE, CLIMATE VIABILITY, AND CHANGES IN PRECIPITATIONS PATTERNS, MAKES SIERRA LEONE HIGHLY VULNERABLE TO THE PRESENT AND FUTURE IMPACTS OF CLIMATE CHANGE. THE RURAL COMMUNITIES ARE OFTEN THE MOST EXPOSED AS THEY LACK TECHNICAL, ORGANISATIONAL, AND ECONOMIC CAPACITIES TO WITHSTAND CLIMATE-INDUCED SHOCKS SUCH AS HEAVY WINDSTORMS, DEVASTATING FLOODS, AND DESTRUCTIVE EROSION.**

The present study aspires to elucidate how 10 rural communities in the Kenema District of Sierra Leone experience local impacts of climate change centring on crucial water, sanitation, and hygiene (WASH) facilities and how to strengthen the adaptive capacities in the communities.

This was achieved through a WASH facility and climate risk assessment of the 10 communities. The assessment showed that windstorms followed by erosion, floods, wildfires, drought, and landslides impact the 10 communities in various ways and degrees.

To further understand how the communities are impacted by climate change, the study investigates how human-induced activities aggravate the impacts of climate change. The study found that deforestation is the main aggravating activity as it takes place in all 10 communities. Mining activities, water pollution, and poor waste management follow suit.

The assessment showed that the toilet facilities followed by handpumps and then waste dump sites are the top three WASH facilities exposed to climate change hazards and aggravating activities in the communities.

With an understating of how climate change impacts and aggravating activities are impacting and taking place in the individual communities, it became apparent to discuss how the communities can adapt to these climate-induced challenges. It was found that adaptation plans must address a series of different technical, nature-based, social, political, and economic components to be successful. Technical improvements, training, and tools are possible instruments to enhance the communities' abilities to withstand climate-induced shocks. Nature-based soluti-

ons are vital elements in restoring biodiversity and the formerly forested areas. Social reconstruction and behavioural changes are needed if the communities are to transition their livelihoods from being based on aggravating activities, such as deforestation and mining, to sustainable cash crops. Political efforts must be accelerated to streamline and expedite climate adaptation strategies on a national level. Lastly, economic structures must be secured in a sustainable matter to ensure the long-lasting improvements of the adaptive capacities of the communities.

Participatory principles are the cornerstones of the climate risk assessment initiative established by SEND SL and EWB-DK. The participatory principles form the frame of the present study with prominence on community mobilisation, climate advocacy, raising awareness and building the organisational capacity of the involved communities regarding climate risk assessments. The participatory element shines through in the data collection methods, where focus groups and key informant interviewees have to go through different interactive exercises to paint a picture of how the individual communities are experiencing local impacts of climate change.

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