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An Empirical Study of the West Africa Ebola on Household Living Standards and the Labour Market: New Evidence for Sierra Leone

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Abstract

This thesis seeks to understand and evaluate the trends in standard of living in Seirra Leone as a result of the West Africa Ebola epidemic. Economic development evolution strain in Africa has stemmed from the era of independence from colonialism. According to (Heldring and Robinson, 2012), the development prospect of Africa's post-colonial rule has been heterogeneous, with different mechanisms to ensure development. However, an overarching negative development indicator from various African countries was associated with the contextual challenges around poverty alleviation methods, economic shocks like disease, war and political stability and labour market fluctuations (Hillbom and Green, 2019). The thesis used various household level data in 2011, 2014 and 2018 to causally estimate the impact of the Sierra Leone Ebola on household living standards. The thesis explores the analysis through the use of Propensity score matching and difference-in-difference estimation method. The results show higher vulnerability on standard of living as a result of the Ebola. The mechanism is heavily associated to the labour market disruption as a result of the quarantine policy.

Preface or Acknowledgements

I give glory and honour to God Almighty for making it possible for me go through this academic journey with determination and resilience. It is only by the Grace of God that I have successfully completed this thesis work and the PhD program in Economics at Selinus University. With conviction to acquire a Doctoral degree which had been a long-time dream, God was by my side in every step of the way to make this dream a reality.

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Table of contents

Contents

List of Figures

List of Tables

1. Chapter 1: Introduction and Aim of Study

1.1 Introduction

Economic development evolution strain in Africa has stemmed from the era of independence from colonialism. According to (Heldring and Robinson, 2012), the development prospect of Africa's post-colonial rule has been heterogeneous, with different mechanisms to ensure development. However, an overarching negative development indicator from various African countries was associated with the contextual challenges around poverty alleviation methods, economic shocks like disease, war and political stability and labour market fluctuations (Hillbom and Green, 2019). In sub-Saharan Africa, the history of economic development has been multidimensional and provides a dynamic approach to economic development (Hillbom and Green, 2019). The paradigm shift from colonialism's impact on economic development to understanding the individual implications of other economic challenges has been a critical driver for African economies. Establishing the United Nations Millennium goals and eradicating poverty shows a clear mandate for development. Nevertheless, African economies, especially in the sub-Saharan region, have seen changing economic challenges from civil and political conflict to disease infestation (Naoussi and Tripier, 2013).

The last decade has seen different evidence of economic shocks that have led to changes within the structure and development of the global economy (Naoussi and Tripier, 2013; Wagstaff, 2005). However, these economic shocks stemming from the impact of diseases, political instability or conflict have gathered high speculation on the developing prospect for least developing countries, especially fragile states (Alam, and Mahal, 2014; Bloom, Cadarette, and Sevilla, 2018). Economic

shocks are associated with low productivity, increased poverty and household welfare, changes in adaption strategies and social disruption to economic markets (Wagstaff, 2005). The issue with economic shocks has had a strong impact on macro-level impacts, and there are fewer accounts for micro-level impact, especially within the context of developing countries. Economic shocks in developing countries have trends from economic conflicts, civil conflict and political unrest (Collier, 2004; Ray and Esteban, 2017.). In addition, developing countries, especially countries in the sub-Saharan region, had seen increased vulnerability to the insurgence of diseases like HIV/AIDS, Malaria and most recently, the 2014 West Africa Ebola Virus (Dixon, McDonald and Roberts, 2002; Reilly and Sam, 2023). These economic shocks have led to a reversal in terms of development structures and policies.

It is important to understand the patterns and trends of economic shocks on household living standards to understand the dimensional impact. However, data limitation and consistency across microeconomic measurements of household living standards have seen limited research, especially for developing countries, especially in West Africa (Bellow and Miguel, 2009; Justino and Verminp, 2019). In a clear and significant economic context, the Sierra Leone economy has witnessed trends of economic shocks that have impacted the development strategies, especially in the fight to reduce poverty and increase economic growth. Hence, the uniqueness of the economic trends is the relevant impact that needs to be accounted for and empirically investigated to show new evidence around the impact of economic shocks on various household living standards.

1.2 Empirical Contextual Background- Sierra Leone

Sierra Leone is a country in the West of Africa and borders with Liberia and Guinea within the Manor region. The Country was under British Colonial rule and gained independence in 1964 with the establishment of its own rule of law and governance. The imperative of development for Sierra Leone has been challenged by different economic shocks. The population of Sierra Leone stood around 8 million, with high proportions within the capital, Freetown. The Sierra Leone economy has faced significant economic shocks in the last ten years, including the West Africa Ebola (Statistics Sierra Leone, 2024; Reilly and Sam, 2022). The economic standard of households in Sierra Leone is key in the implementation of the national development goals and the United Nations Sustainable Development Goals (World Bank, 2023). Imperatively, the Sierra Leone economy was recovering from the 11 years of civil war that impacted the Country between 1991 and 2002 (Bellow and Miguel, 2009; Reilly and Sam, 2022). The war has led to policies around reconstruction and development. The Sierra Leone economy was on the trajectory of increasing its economic status, with GDP increasing in the last five (5) years and a reduction in inequality and poverty rate (World Bank, 2023). Access to economic conditions was improving from pre-war levels with a good effort in terms of political stability. The World Bank Poverty alleviation program has been sustained throughout the period with a bigger picture of reducing poverty through education and the provision of health services.

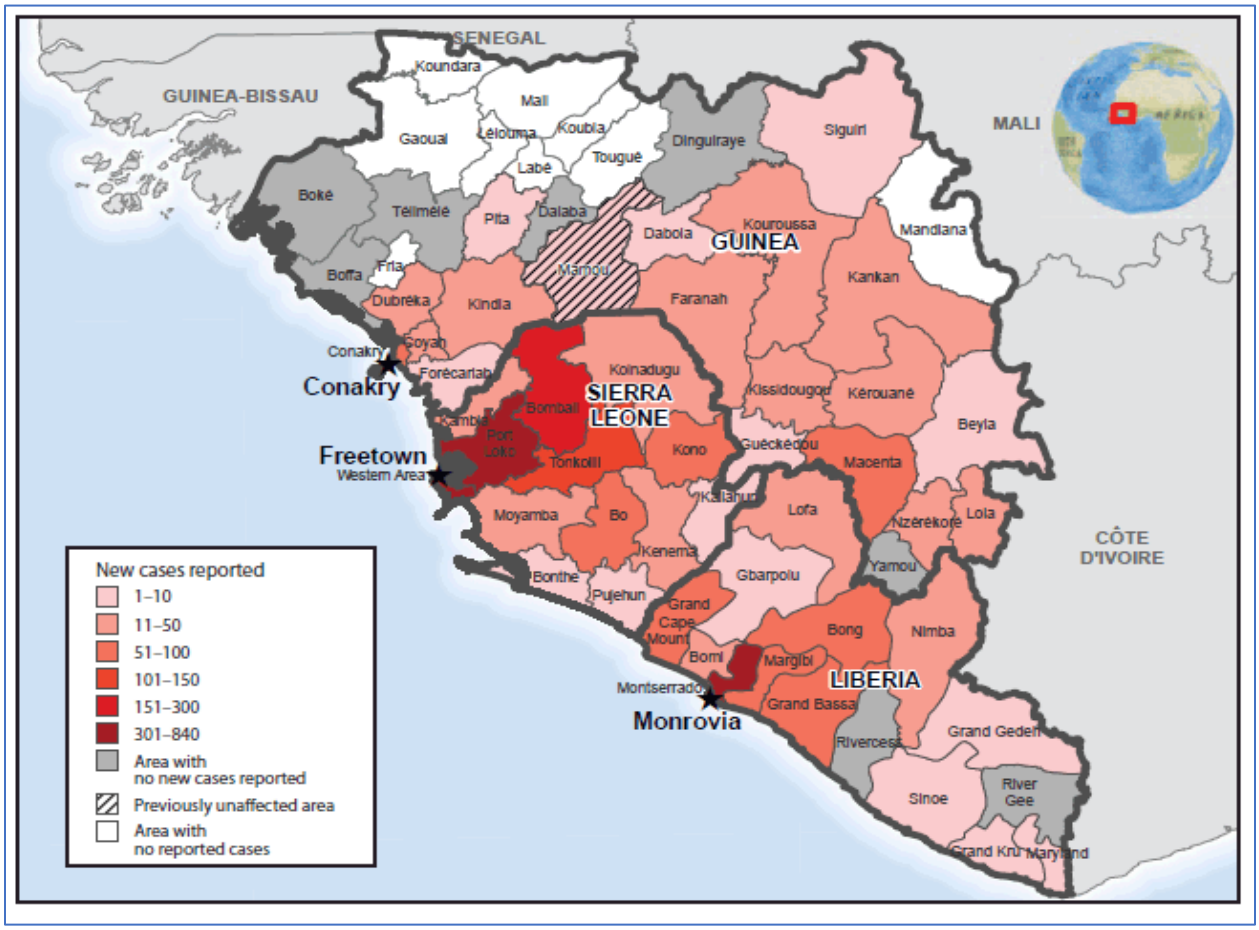
The Ebola virus outbreak in Sierra Leone accounted for more than 4,000 deaths and over 14,000 cases and was declared an epidemic by the World Health Organisation on the 23rd of March 2024 (NIH, 2020). The traditional and cultural approach to burial duties is implicated in the spread of the disease. The outbreak was exacerbated by behavioural attitudes and close contact. The Ebola

virus is associated with a Zoonotic virus strand that was first discovered in the Democratic Republic of Congo in 1976 and has evolved across different versions in the African continent. However, the different Ebola virus outbreak was not associated with an epidemic until the 2014 West Africa outbreak. The lack of vaccines or medication led to a devasting impact in the region. The Ebola virus outbreak in West Africa was deemed to be spread by human contact with an animal, and the transmission led to increased fever symptoms and haemorrhage through the eyes, nose, and ears at the critical stage. The Virus has an incubation or period towards asymptotic of about 21 days and can spread through fluid contacts from the infection. The Virus is critical and more aggressive than other viruses like the coronavirus, and it can lead to death within five (5) days (Kerkhove et al., 2015; Sam, 2021). The Virus was only curable through an immune fight as the lack of vaccines and treatment makes it difficult to control. The Virus also impacts Nigeria and the United States, especially medical personnel travelling from the manor region (Sierra Leone, Guinea, and Liberia).

The Sierra Leone economy was in recovery from the civil war with political stability when the Ebola Virus was discovered within the Manor region. The 2014 West Africa Ebola outbreak started in Sierra Leone, with the first case identified on the 24$^{th\ of}$ May 2014 in Kenema, on the eastern border towards Liberia. The Ebola virus outbreak impacted Guinea and Liberia, which are immediate neighbours to Sierra Leone. Nevertheless, the incidence and death rate for Ebola-related cases in Sierra Leone was the highest as compared to Guinea and Liberia. Sierra Leone was one of the hardest-hit economies as a result of the 2014 Ebola outbreak (World Health Organisation, 2023; Sam, 2021). This economic shock of the disease was accompanied by a political decision to lockdown the economy to stop the spread of the Virus, leading to economic

implications with a state of emergency declared by then President of Sierra Leone on the 31st of July 2014 (Oxfam, 2024; Dumbuya, and Nirupama, 2017). As indicated in Figure 1 below, the spread of new cases was prominent in Sierra Leone and the surrounding countries. The inability to understand the Virus due to the lack of vaccine and treatment led to the political decision to lock down, which is mostly accompanied by epidemics.

*Figure 1**: The Ebola Outbreak – Spread of Ebola Cases according to Country.***

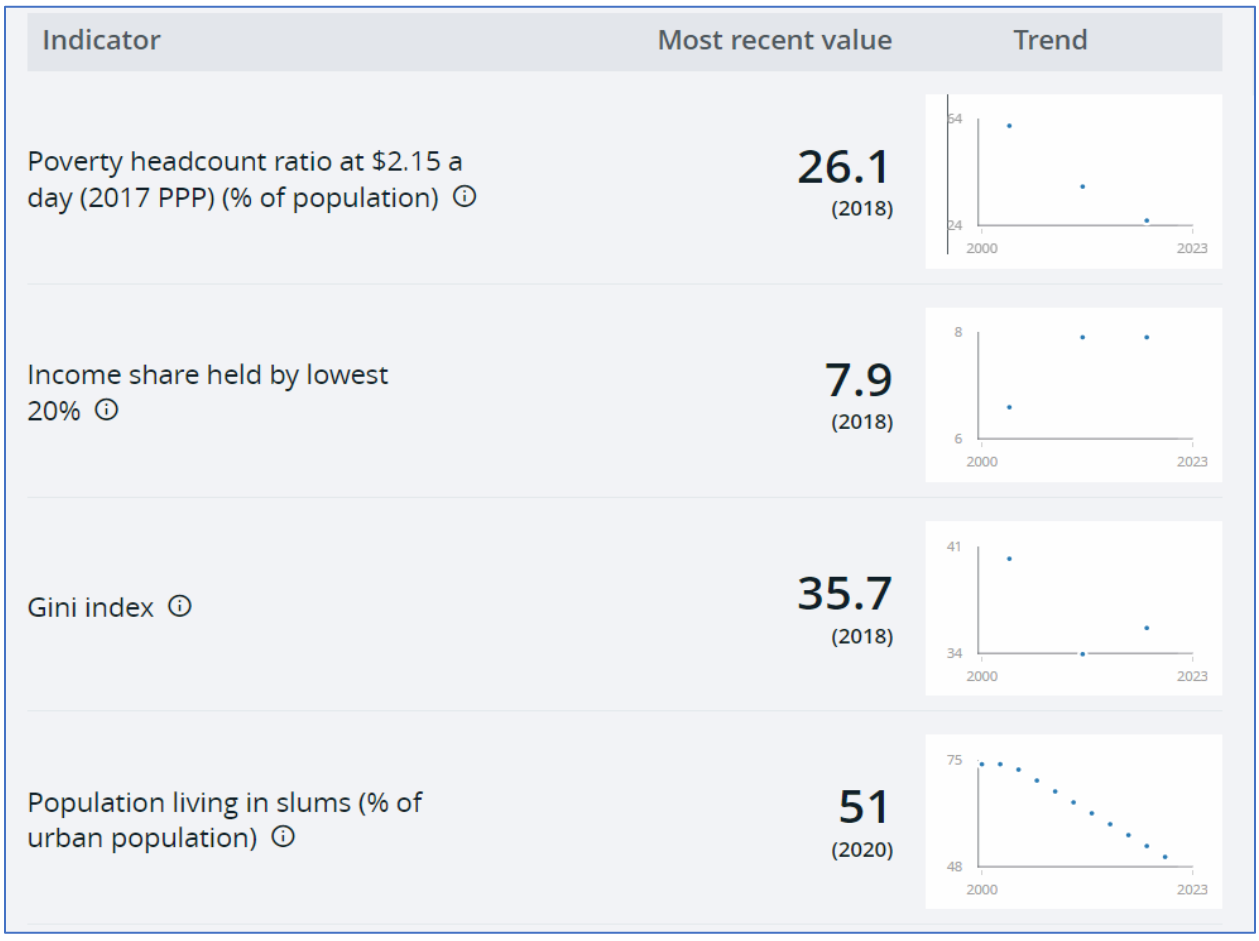


Source: The centre for Disease Control, Ebola Outbreak case report, 2014

The lockdown policy was enacted in Sierra Leone to stop the contagion of the Virus. Lockdown policies have been an approach in the recent pandemic caused by the coronavirus outbreak. The

prediction from Siettos et al. (2017) in evaluating the evolution of the Ebola virus and the contagion rate shows a higher rate of about 77% chance through social interactions using the 6 million population during the outbreak in 2015. It was essential to understand that the predictive power of the increase in cases was due to the lack of vaccines, the social structure of Sierra Leoneans (communal) and the density of economic activities like marketplaces and transportation. In addition, the public health standards for Sierra Leone were poor, and the Ebola virus exposed the weakness of the structure and the health care provisions.

*Figure 2**: Broad Standard of Living Indicators and Trends, Sierra Leone***



Source: The World Bank Data, 2024

The economic and living standards in Sierra Leone were in recovery before the Ebola outbreak. According to the World Bank, the economy was experiencing an increase in Gross Domestic Product with the trajectory towards a middle-income country by 2035 (World Bank, 2023; Sam, 2021). As indicated in Figure 2 above, the trends in poverty status decreased before 2014 but still show prevalence after the outbreak, standing at 26.1% in 2018. This is also associated with an increase in the share of individuals at the bottom of the income quintiles to be increasing. There has been an insurgence in the level of inequality, especially since the Ebola outbreak. Nevertheless, the population living in slum areas still makes up more than 50% of the population after the Ebola. Hence, it is imperative to understand the impact of Ebola on households living standards from a multidimensional strand to validate policies that will increase growth.

The Sierra Leone government's Ebola recovery response indicated the recovery of the economy after the official closure of the post-conflict recovery mandate from the United Nations in March 2014. The economy showed resilience in the last decade before the Ebola outbreak as the GDP increased steadily from 15.2 percent in 2012 to 20.1 percent in 2013 and a significant drop in poverty status by 18 percentage points. The recovery response indicates a 2-year implementation strategy around the aspect of restoring and providing basic health facilities, increasing social protection and support for education and increasing the agricultural sector (Government of Sierra Leone(GovSL), 2015). It is relevant to indicate that the labour activities of households in Sierra Leone are broadly associated with agricultural activities. This was mapped out in an Ebola recovery strategy policy with a vision of prosperity for 2035. The United Nations Development Programme (UNDP) collaborated with the World Bank, Statistics Sierra Leone and the International Poverty Actions (IPA) to facilitate the recovery response (GovSL, 2015).

1.3 Research Aim and Questions

The thesis embraces multi-disciplinary evaluation across economics, public health, and social behaviours as an integral tool in understanding the living standard resulting from economic shocks. This thesis seeks to evaluate household living standards across the last ten (10) years to understand the patterns and implications of economic shocks on household living standards, with a special investigation of the 2014 Ebola virus outbreak.

1.4 Research Questions

The research question will focus on the following:

1. An evaluation of the standard of living impact from Ebola through the lenses of multidimensional or unidimensional impact.
2. What are the short-term and long-term consequences of Ebola on Household living standards?
3. What are the long-term implications of Ebola on household living standards and the mechanisms from human capital accumulation (education and health) on the labour market?
4. What are the practical policy recommendations for a target-based economic enhancement package for the affected Ebola households?

1.5 Research Hypothesis

The above research questions will build on the hypothesis motivated from the contextual background as follows:

Hypothesis 1: To test the validity of the 2014 West Africa Ebola outbreak to have had a significant negative impact on the household living standards in Sierra Leone, leading to measurable declines in income levels and other standards of living indicators and labour market outcomes compared to pre-Ebola period.

Hypothesis 2: To test the validity that the Ebola impact is more pronounced in chiefdoms with high outbreak of the Virus and prolonged period of lockdown.

This chapter has provided an overview of the contextual evaluation of Sierra Leone Ebola, its impact on the economy, and the relevant strategies or responses from the government of Sierra Leone and international health organisations. In addition, the chapter expands on the relevant research aims and questions. Finally, the chapter indicates that the enhancement of the research questions will be analysed through the hypothesis formulation. The next chapter will provide an extensive and critical evaluation of the literature to understand the impact of the Sierra Leone Ebola on household living standards.

2 Chapter 2: Literature Review

2.1 Introduction

In evaluating and empirically analysing the impact of the Sierra Leone Ebola Virus outbreak on household living standards and labour market outcomes, this chapter will provide an in-depth and critical evaluation of the relevant literature. Firstly, the literature will present an overview of the different measures of standard of living, the theoretical assumptions and the empirical justifications within the context of Africa. Secondly, the literature will provide an evaluation of the economic shocks stemming from diseases on household living standards. However, the heterogeneous and multidimensional assessment of the standard of living and the relationship matrix with economic shocks will be evaluated. This will then be proceeded by the empirical analysis of the impacts of the Ebola on household living standards and empirical studies for Sierra Leone. Finally, the literature will provide an understanding of the gap in the literature that substantiates the relevance of this research.

2.2 Evaluation of Standard of living indicators and labour market outcomes

In the evolution of the standard of living dimensions and measures, international organisations have resorted to the aspect of the standard of living that is important for human development. The evaluation of standard of living goes beyond the measures of economic growth, but one embraces the multidimensional aspect of well-being (Bérenger and Verdier-Chouchane, 2007). In embracing the theoretical application of standard of living around multiple dimensions, the work of Sen on social justice and inequality holds precedence in understanding the indicators or measures of standard of living. The theory of social welfare through measuring capability

approach to measuring standard of living builds the concept of development and the construction of the United Nations Development Program (UNDP) Human Development Index (HDI) in 1990 (Bérenger and Verdier-Chouchane, 2007). The HDI was one of the multidimensional indicators of standard of living, away from the single indicator structure like the use of Gross Domestic Product (GDP) Per capita income as a measure of well-being. The work of Bérenger and Verdier-Chouchane (2007) provides a comparative study across 52 African countries to understand the indicators of well-being through measures of standard of living indices or those that account for quality of life indices based on Sen's capability approach. The analysis embraces the totally fuzzy analysis (TFA) and the factorial analysis of correspondences (FAC) to evaluate and identify the important indicators for well-being compared to the general HDI and GDP per capita indicators of standard of living.

The mandate to evaluate different well-being indicators through the standard of living indicators and the Quality of Life indicators is key to this research. The essential indicators of standard of living derived from the work of Bérenger and Verdier-Chouchane (2007) link to nine indicators. The indicators range across three dimensions of well-being, which are health, education and material well-being. Hence, indicators like the expenditure percentage of developing countries on health, social services, doctors-patient ratio, accessibility and safety measures are key indicators of Standard of Living. The relevance of education access, buildings, accessibility, the teacher-student ratio, the gender ratio in schools, and, most importantly, free or private primary education are key indicators. Hence, these indicators provide an understanding of the micro-level assessment of poverty, well-being and inequality. On the other hand, the quality of life approach shows indicators around human freedom and population opportunities and captures questions about the

quality of education, health facilities, and not just availability. It also includes measures of adult literacy and measures of gender capabilities. It also includes issues around Life expectancy, maternal mortality and political freedoms. In evaluation and justification within the research objective and for the context of Africa, the measures of standard of living are essential factors that are the first step in enhancing the well-being of households and individuals. Hence, this study will focus on the indicators stemming from the standard of living approach.

In the contextual evaluation of developing countries, the indicators and measures of living standards are multidimensional and relevant for different contexts, with contradicting views and perspectives (Sen, 1989). The historical conceptual discussion shows the understanding of living standards measures to be associated with the complex ideas around livelihood through income and consumption styles (Bennett, 1937). However, Cottam and Mangus (1942) evaluate the importance of subjective happiness and continent as a measure of living standards. As indicated above, the work of Bérenger and Verdier-Chouchane (2007) measures of living standards are multidimensional and can include objective measures based on expenditure or monetary values but also self-assessment of individual perception about the overall satisfaction in life. Indeed, the majority of the standard of living indicators have evolved around the income level in society and the judgement around consumption and spending (Cooper, Fabian, and Krekel, 2023). However, the multidimensional views of living standards also show a connection to savings and the ability to meet basic needs, and autonomous consumption income is not the only factor governing spending. Other factors, such as loans and savings, contributed to the spending behaviour. Hence, it gives an overview of poverty or welfare levels, which can stem from objective to subjective measures (Baulch and Hoddinott, 2000).

The literature on the standard of living has shown immense connections between the understanding and evaluation of measuring living standards and key elements that reflect both the objective and subjective perception of welfare (Oulton, 2012). According to Ngo (2018), the measurement of living standards is linked to the theory-based application of poverty index evaluation. The approach of assessing standard of living as an indication of poverty, hence providing policy measures that can reduce poverty and increase growth and development, is key for developing countries, especially for African nations. This thesis aims to provide an approach to understanding the multidimensional approach and providing holistic policies around reducing and alleviating poverty, which is within the development goals of African countries. Most importantly, African countries have derived from the millennial development goals on monitoring poverty alleviation policies. The work of Deaton (2010) provides an evaluation of monitoring global poverty in measuring the millennium development goals through selected poverty lines. The evaluation of poverty can be done by using a single international line or the conversation line using purchasing power parity (PPP) and specific country-specific poverty lines. The measures of poverty provide monitoring of the performance through the use of national data and distributional data through household data on income and consumption. Hence, the extent of aggregating growth and poverty benefits for the poor can increase the risk of pre-judging the important issues around subjective poverty (Deaton, 2010).

In understanding the conceptual evaluation of economic shocks on an economy, the macroeconomic impacts have provided a general discussion on theories of productivity (Chen, Snowerand Zoega, 2003; Dabla-Norris, Minoiu and Zanna, 2015). These theories have built upon the work of general productivity models like the Solow growth model, which determines the

economic factors that increase growth. Hence, the evaluation of standard of living now draws on the importance of increasing capability through labour market indicators. The labour market outcomes of individuals and households can provide a good evaluation of the mechanism through which economic shocks can impact indicators of poverty and standard of living. Hence, issues around gender disparities within the labour market are also indicators of the general welfare and children's outcomes within households (Kabeer, 2021). The issues around inclusive growth and labour markets are some of the household discussions and policies for increasing standard of living in African countries (Ogujiuba and Jumare, 2012).

2.3 Impact of Economic shocks on indicators of standard of Living and labour market outcomes

Economic shocks can be associated with an exogenous impact on growth patterns, and empirical research has shown depreciation in economic growth and a long-term impact on growth. However, different elements of economic shocks ha.ve different impacts on development, especially within the contextual background of developing countries (Bazzi and Blattman, 2014). Economic shocks have generally had a negative impact on growth, but some theories have shown different aspects, especially in terms of capital allocation and scarcity of economic resources (Chen, Snower, and Zoega, 2003).

In the over-understanding of economic shocks, the micro-level aspect of analysis has been limited, and hence, the triple-down impact on individual welfare has not been clearly addressed. The microeconomic level analysis of economic shocks has shown a reduction in the income levels,

local household consumption and increased poverty. There is also the impact on the labour market, indicating poor engagement within the different sectoral productivities Carlsson, Messina, and Skans, 2016). The work of Silva and Matyas (2014) shows how economic shocks associated with low rainfall reduce productivity and other living standard measures. There is also the impact of human capital accumulation on households and individuals for certain economic shocks like conflict and diseases (Verwimp, Justino and Brück, 2019).

According to the work of Teal (2021), economic shocks in the form of disease through the recent pandemic of the Coronavirus has a negative impact on both rich and poor countries. The structural impact of unexpected disease outbreaks is the challenge to understanding the disease while adapting to the ongoing institutional ramifications. The impact of the Covid-19 on countries in the sub-Saharan Africa was linked to two dimensions, which include immediate health issues and the impact on commodity prices. The potential consequences of the changes in commodity prices are that they reduce the welfare adaptation for African countries, which also depend on the aid and support of developing nations. The long-term issues around providing high-quality jobs and educational skills are key to overcoming the impact on disease on economic growth and development.

Along the same line, the work of Jain, Budlender, Zizzamia and Bassier (2020) shows that the Covid-19 have an estimated negative reduction on employment by 40% in South Africa and increasing the vulnerability to poverty by 20-30%. The exploitation of the mechanism, which is through the lockdown policies, saw an increased burden on social services, which did not

proportionally meet the overall population. The understanding of the Covid-19 on households' early labour market impacts in developing countries, Khamis et al. (2021) use high-frequency phone surveys across different countries. The impact shows that work stoppage was one of the key outcomes on labour market outcomes, which account for 34%. Most importantly, looking at the distributional impact, high-income countries show lower loss in incomes and compared to middle and lower-income countries. Agricultural households were less affected has compared to other households, especially those in the service sector. There was also the issue of job relocation across different sectors.

Egger et al. (2021) also provides a quantitative analysis of falling living standards for nine African countries due to the Covid-19 outbreak. The study shows that the fear of disease and the restriction in terms of movement or social distancing challenge countries in modifying consumption and working patterns. Hence, economically vulnerable households in low and middle-income countries were severely impacted and faced increased threats to their livelihoods. The study, using household surveys, shows that over 30,000 households were impacted by different household living standards. The impact was different across countries with different income levels. In industrialised countries, economic losses were mitigated by the government, while the lack of safety nets and savings for developing countries led to increased vulnerability and increased health impacts.

2.4 Evaluation of Economic Shocks on Sierra Leone Standard of Living

In empirical studies for Sierra Leone, the most important work has been around the implications of poverty and inequality as a result of economic shocks like conflict and diseases. According to Bellow and Miguel (2009), the impact of the Sierra Leone conflict leads to increased poverty but also leads to household social cohesion and economic integration. In addition, economic shocks in terms of diseases have also indicated mixed outcomes in terms of household inequality (Reilly and Sam, 2022). Using household microdata before and after the Sierra Leone civil war, Sam and Reilly (2022) show that households in prolonged areas of conflict have increased poverty and low standard of living. However, the evaluation of the Ebola Virus has been limited for Sierra Leone, but the work of Sam (2021) shows that the Ebola virus increases poverty but reduces the level of inequality with redistribution from the rich to the poor.

Helleringer and Noymer (2015) provide a non-empirical analysis of the direct effect of the Ebola outbreak on life expectancy in Liberia, Sierra Leone and Guinea. The study shows that the Ebola outbreak impacts life expectancy through different pathways but, most importantly, through the direct impact on death rate through the high mortality rate of the virus. Also, the long-term implications of the disease on the health of the survivors are associated with high health risks, which can implicate the household in terms of medical expenses, food security, reduction in the potential to provide economic activities, and hence loss of income. The culmination of these indicators will reduce the standard of living of a household affected by Ebola and individual life expectancy.

In addition, the Ebola virus in West Africa has indirect costs to the economies. The estimated cost of economic losses is high and increases the economic burden for the affected countries. Ebola exposes the health facilities, and the concerns around human rights and global security cloud the judgement around investment in domestic and international markets for Guinea, Liberia and Sierra Leone, which increase the vulnerability (Kirigia, Masiye, Kirigia and Akweongo, 2015).

It is imperative to note the gap in the literature in understanding the extent of the micro-level impact of Sierra Leone on household living standards. The studies are limited to empirically evaluating the impact of the Ebola virus on different indicators of standard of living to capture the essence of the multidimensional implications of disease outbreaks. Hence, this thesis will provide new evidence on the Ebola virus, which had similar contagion policies of lockdown as the Coronavirus pandemic on household living standards. The aim is to provide a holistic outlook on how developing countries can provide relevant and useful policies to mitigate the negative implications of disease outbreaks on household living standards.

3 Chapter 3: Data and methodology

3.1 Data

In contextual evaluation, The Ebola started in Sierra Leone in August 2014, and the Country was declared Ebola-free by the World Health Organisation (WHO) in 2016. The Ebola-related fatalities stood at around 4,000 deaths and nearly 14,000 incidences of the Virus (Holbrook, 2020). In empirically evaluating the trends and patterns of the 2014 West Africa Ebola Virus outbreak on household living standards, the thesis aims to give a casual estimation using relevant household survey data at the micro level. The thesis explores three important household surveys to examine the pre-Ebola and post-Ebola impact on household living standards and consequences.

The data have been selected to ensure clear empirical estimations of relevant household indicators before and after the Ebola Outbreak. Therefore, the evaluation will explore the 2011 and 2018 Sierra Leone Integrated Household Surveys (SLIHS) and the 2014 Labour Force Survey (LFS) for Sierra Leone. The central research aim is to critically evaluate the impact of the 2014 Ebola on various household living standard measures and labour market implications based on different household compositions. The 2011 and 2018 SLIHS are part of the National Statistics Office generation of information on the household economic and social conditions in Sierra Leone. The surveys are done with collaboration and follow the World Bank standards of household surveys like the household living standards surveys (World Bank, 2023).

The 2011 SLIHS provides pre-Ebola information on the household living standards in Sierra Leone. In addition, the 2018 SLIHS gives the post information of households after the Ebola

outbreak. These two surveys will provide an understanding of the consequences of Ebola on living standards in Sierra Leone. However, to provide a holistic mechanism for household living standards that goes beyond monetary evaluation, the 2014 LFS provides central information on the labour market before and around the time of Ebola in Sierra Leone. Hence, the evaluation will provide a policy insight into the multidimensional implications of economic shocks across different living standards to understand the best policy approach to increasing the living standards for Sierra Leone. Therefore, the Sierra Leone Labour Force survey in 2014 will give some relevant understanding of the short-term impact and how it will link to the long-term impact of Ebola using the 2018 SLIHS. These two survey data will be evaluated against the pre-Ebola 2011 household survey, which forms the benchmark.

The selected household surveys provide the smallest demographic information in terms of chiefdom-level analysis, which ensures comparison across the years and the measures of living standards. The aim is to provide consistency and reduce bias in the empirical analysis. However, a descriptive analysis from other household surveys gives an economic outlook of the general standard of living for Sierra Leone using the Multiple Indicator Cluster Survey (MICS) 2017 and the Demographic Household Survey (DHS) 2019 for long-term comparison. It is worth noting that these two surveys have household demographics at the district level, which is much more aggregated compared to the chiefdom-level data from the SLIHS. Hence, it does not form the primary data for our analysis as the 2011 and 2018 SLIHS give smaller demographic information, which has an in-depth structure on the micro-level indicators of households and individuals.

In addition, there will be a semi-structured interview with stakeholders from the Health Ministry and the Ministry of Economic Development to get some policy views on the implications of Ebola on household living standards and labour market outcomes in Sierra Leone. The interviews will be conducted with a sample of 5 officials from the Ministry of Health and the Ministry of Economic Development. A semi-structured interview, as opposed to a questionnaire, has been used as a further data collection tool to provide current and relevant policies by the government. The data will provide useful discussion on the empirical findings from the household data. This approach of mixed methods provides a holistic evaluation of implications and policy contributions for economic shocks in a vulnerable country like Sierra Leone.

Ethical considerations around the sensitivity of the use of personal information are restricted as the survey follows national and international standards, and the published results from Statistics Sierra Leone are anonymous and reflect high ethical considerations. Hence, for the semi-structure interviews, an anonymous coding approach for respondent is established for the primary data consideration (see Appendix 1). The transcription from the semi-structured interviews from the two open-ended questions will provide some indicator policy tools established within the Sierra Leone economy in terms of institutional contributions of the Ebola on economic conditions.

3.2 Data Sample Description 2011 and 2018 SLIHS and the 2017 LFS

The 2011 SLIHS accounted for 6,840 households representative across the country and the local distributes. In Sierra Leone, as of the 2011 survey, there are 13 districts with local distribution of main cities and municipalities. As indicated in Table 1 below, the sample households were representative across rural and urban regions.

Table 1: Sample Distribution of Households across districts and Eunemartion Area- 2011 SLIHS

Domain/Local Councils	Sample Household			Sample EA		
	Total	Urban	Rural	Urban	Rural	Total
Kailahun District	540	80	460	8	46	54
Kenema District	570	90	480	9	48	57
Kono District	360	40	320	4	32	36
Bombali District	420	30	390	3	39	42
Kambia District	310	60	250	6	25	31
Koinadugu District	360	30	330	3	33	36
Port Loko Distri	550	90	460	9	46	55
Tonkolili District	430	70	360	7	36	43
Bo District	440	50	390	5	39	44
Bonthe District	230	20	210	2	21	23
Moyamba District	370	30	340	3	34	37
Pujehun District	290	30	260	3	26	29
Western Area Urban	1120	1120	0	112	0	112
Western Rural District	250	150	100	15	10	25
Bo City	190	190	0	19	0	19
Bonthe Municipal	20	20	0	2	0	2
Kenema City	170	170	0	17	0	17
Koidu/New Sembehun City	120	120	0	12	0	12
Makeni City	100	100	0	10	0	10
Sierra Leone	**6840**	**2490**	**4350**	**249**	**435**	**684**

Source: Sierra Leone Integrated Household Survey Report, 2011

In addition, the 2018 SLIHS also shows a total sample of 6,840 households across 684 clusters as indicated in table 2 below.

Table 2: Sample Distribution of Households across districts and Eunemartion Area- 2018 SLIHS

		Cluster			Household		
No	**District**	**Rural**	**Urban**	**Total**	**Rural**	**Urban**	**Total**
1	Kailahun	23	15	38	230	150	380
2	Kenema	27	29	56	270	290	560
3	Kono	24	15	39	240	150	390
4	Bombali	46	30	76	460	300	760
5	Kambia	15	6	21	150	60	210
6	Koinadugu	28	10	38	280	100	380
7	Port Loko	30	20	50	300	200	500
8	Tonkolili	19	11	30	190	110	300
9	Bo	35	32	67	350	320	670
10	Bonthe	24	6	30	240	60	300
11	Moyamba	20	2	22	200	20	220
12	Pujehun	50	2	52	500	20	520
13	Western Area Rural	3	27	30	30	270	300
14	Western Area Urban	0	135	135	0	1350	1350
	Total	**344**	**340**	**684**	**3440**	**3400**	**6840**

Source: Sierra Leone Integrated Household Survey Report, 2011

The socio-demographic and the characteristics of the household members include age, gender, religion, marital status, the relationship to the head of the household, the educational level of the household head and household size. This is consistent information in terms of definitions of the 2011 and 2018 SLIHS. In addition, the chiefdom disaggregation from the districts in Sierra Leone was 153 chiefdoms (149 provincial chiefdoms and 4 municipals) in 2011 but disaggregated to new chiefdom levels in 2017, making up about 190 chiefdoms in the 2018 SLIHS (Statistics Sierra Leone, 2018). However, for the empirical analysis, the old 2011 chiefdom aggregation will be applied to the 2018 data for estimated consistency. The demographic characteristics are similar to the one adopted in the Sierra Leone Labour Force survey, which is also representative across the

districts. However, a total of 4,200 households and 200,000 individuals were covered in the 2014 Sierra Leone Labour Force Survey (Statistics Sierra Leone, 2014).

3.3 Methodological Approach

3.4 Introduction

In order to provide a critical evaluation of the impact of the Ebola outbreak on household living standards indicators within Sierra Leone, the empirical approach follows the distinction of households by allocating households to the high incidence of Ebola outbreak chiefdoms in terms of death rate and prolonged period of the lockdown policy area. The Ebola Virus impacted all regions of Sierra Leone. The severity in terms of death and lockdown varies across the regions. The Eastern and South regions saw a high prevalence of Ebola-related deaths as compared to the North and some regions in the West.

3.5 Ebola Treatment or Dependent Variable

In order to provide the estimated impact of the 2014 Ebola on household living standards, the methodological approach uses information on treatment variables. The treatment variables show the estimation measure of Ebola. The Ebola treatment variable is created by the allocation of households based on Ebola exposure and the lockdown policies used to curtail the virus. Hence, the treatment variable is a dummy variable, taking the value 1 if a household falls within chiefdoms that witnessed a high death rate and prolonged lockdown period and zero otherwise.

This empirical approach allows for the assessment of the causal impact of Ebola on household living standards. The information on the related death incidence and the lockdown policy was established from the World Health Organisation report on Ebola and the data presented to the Sierra Leone government from the National Center for Disease Control and the Ministry of Health. The use of dummy variables down to chiefdom level allocation is due to the smallest geographical unit within the SLIHS and the LFS. Hence, the main dependent variable in this analysis is Ebola, measured through the death incidence and the lockdown policy.

3.6 Independent Variables of Household Standard of Living Indicators

As indicated from the literature review, the living standards indicators that will be evaluated in this thesis include household expenditures, household poverty levels, and different dimensions of household savings. In addition, the HDI index for Sierra Leone will be evaluated together with expenditure quantiles to show the distributional impact. These different dimensions of living standards will account for the general outlook of the household living standards in Sierra Leone. In terms of the mechanism, the labour market outcomes include household head occupational sector, wage structure and public health indicators.

3.7 Empirical Estimation Methods

The main empirical analysis explores the difference-in-difference econometric estimated method. The estimation is based on the calculation of the impact of Ebola before and after, and the difference is taken to show the causal impact of the Ebola outbreak. This follows the non-traditional difference-in-difference method, as the data are cross-sectional surveys and not panel

data. The main empirical estimation method is established below. This approach follows the approach of Sam and Reilly (2022).

Firstly, the method builds from the establishment of a treatment assignment equation based on household allocation into Ebola- or non-Ebola-affected households. The treatment assignment equation provides the probability of a household being within the Ebola chiefdoms based on virus incidence and the lockdown policy and is estimated using a logistic regression model. The estimation of the logistic model takes into account a set of independent or explanatory variables at the household level. The explanatory variables included in the logistic model in determining the probability of a household in the Ebola or treatment group are not informed by any underlying economic theory and can include polynomial interactions across different variables. The aim is to provide the highest probability outcome of a household being in the treatment based on household characteristics that are not affected by the treatment variable (Ebola) but have implications for the dependent variables (household living standards indicators). Hence, the aim of the logistic regression is to get predictive power by constructing propensity scores with effective balancing properties across household characteristics between Ebola and Non-Ebola regions.

Secondly, the estimation uses the Propensity Matching (PSM) estimation strategy (Smith and Todd, 2001; Dehejia and Wahba, 2002). This estimation strategy will account for a random allocation simulation based on household characteristics that are not influenced by the Ebola virus. These household characteristics include the age, sex and education level of household heads. The household size, the marital status of heads and the religious background. In addition, the regional

allocation (East, West, South and North), dependency ratio, and other characteristics are not directly influenced by Ebola. This is a conceptual assumption in the PSM approach called the unconfoundness or the conditional independence assumption (CIA), which will validate the matching process to be random, leading to a causal interpretation (Heckman and Todd, 1997).

Thirdly, the estimation of the propensity score for the treatment and control groups is calculated within a common support delimination to exclude non-overlap in the data using the Epanechnikove kernel density with 0.08 bandwidth, as it was the most effective after random estimation. Before the estimation of the Average Treatment Effect (ATT) of the Ebola outbreak and the associated lockdown policy, the input variables in the treatment assignment equation should have a similar distribution. This accounts for the matching quality, which is estimated by further generation of the balancing properties or the marginal distribution. The standards approach to ensure the treatment and control group have no observational differences. The Rosenbaum and Rubin (1985) approach, through comparison of t-statistics, variance ratios (F-tests) are used to establish if the balancing property holds. The pseudo R^2 should be close to zero, and the overall likelihood ratio test for the overall significance of the logistic model should be low.

The aim of the above approach is to compare households that have been affected and not affected by Ebola with similar characteristics. Hence, any estimation difference between these households will be associated with the Ebola impact on the corresponding living standard indicators. Hence, the outcome will be the Average Treatment Effect (ATT) of the Ebola outbreak. Hence, the ATT for 2011, which is the pre-Ebola effect, will be estimated and established as ATT_0. For the Short-

term impact and labour market outcomes, the ATT from the 2014 LFS will be ATT_1 and the difference-in-difference between ATT_1 and ATT_0 will give the short term impact. The 2018 ATT will be estimated as the post-ebola effect and established as ATT_2. Then, the Ebola Average Treatment Effect on the Treatment will be the difference-in-difference between ATT_2 and ATT_0. This will have a long-term impact on Ebola.

The propensity score matching allows for the removal of measured confounder biases, especially for cross-sectional surveys. However, the difference-in-difference method eliminates the bias from unmeasured confounders across time. Given that the data is not panel data, the combination of PSM and the non-traditional difference-in-difference gives a reliable causal estimation of the Ebola impact on household welfare.

The limitation of the PSM is the lack of a simulation application that can be implemented through impact evaluation. However, in addition to the above, the empirical strategy will also seek to apply an instrumental variable estimation approach to provide a robustness check for the PSM approach (Newhouse and McClellan, 1998). The instrument will use the economic shock of rainfall, which has a direct impact on household living standards, especially given that the majority of households in Sierra Leone are agricultural households. However, rainfall did not have a direct impact on the Ebola outbreak, which makes it a relevant instrument that meets both criteria (exogenous and exclusion) (Newhouse and McClellan, 1998). The rainfall data will be calculated using satellite data for chiefdoms in Sierra Leone in 2011, 2014, and 2018 (see Appendix 2).

4 Chapter 4: Descriptive Statistics and Empirical Results

4.1 Introduction

This section of the thesis provides an overview of the descriptive statistics from the selected data sets in understanding the impact of the Sierra Leone Ebola on household living standard trends. In addition, the empirical results will be presented based on the estimation techniques and an attempt to quantify the casual impact using the non-traditional difference-in-difference method discussed in the methodological section.

4.2 Important Descriptive or Summary Statistics

In understanding the impact of the Sierra Leone Ebola on household living standards, specific independent variables will be identified from the overall theoretical approach and empirical literature. In line with the data available for Sierra Leone, Table 3 below outlines the indicative dependent variables and description. In addition, the main treatment variable is also underpinned in the table.

Table 3: ***Independent and Treatment Variable Description across the relevant data sets***

Standard of Living Indicators	**Variables**	**Variable Description**
Expenditure	Hou_exp	This is a continuous variable that is the log of household total expenditure. Other categories include Food and Non-food expenditure
Objective poverty	Pov_obj	This variable is a dummy variable that measures the amount of households in poverty by taking the value 1 and 0 otherwise, based on the national poverty line.
	Food_pov	This variable is a dummy variable that measures the amount of households in food poverty by taking the value 1 and 0 otherwise, based on the national food poverty line.
Subjective Poverty	Pov_sub	This variable is a dummy variable that measures the amount of households that indicate to be subjectively poor by taking the value 1 and 0 otherwise, based on subjective measures.
	Food_pov	This is a variable that takes the value 1 if a household subjectively said they have difficulty (sometimes and always) in satisfying food demand in the last 12 month and 0 otherwise.
Savings **(categorical)**	Durable Assets	This is a categorical variable that captures household savings or asset levels on their living standards relative asset counts. =1 no durable assets =2 (average durable assets) =3 (more durable assets)

	Lend_Cap	This is variable that is categorical variable that reports household ability to borrow and meet living expenses in the last 12 months =1 (always/often) =2 (sometimes) =3(Never/seldom)
Labour Market Outcomes	Hou_occ Emp_status	The first variable is a categorical variable that indicates the household head occupation. The second employment status of the head of household.
Treatment	Ebola Cases	This variable is a dummy variable that takes the value of 1 if a household is within a chiefdom that had Ebola related cases (confirmed cases) and it is 0 otherwise.
	Quarantine	This variable is a dummy variable that takes the value of 1 if a household is within a chiefdom that was lockdown because of Ebola related cases and it is 0 otherwise.

Source: Author's own compilation, Thesis, 2024

Table 4: The Raw Statistical Differences in mean for objective poverty by Ebola Confirmed Cases in chiefdoms

	Objective poverty					
	Poor			**Food**		
Years	No Ebola	Ebola Cases	Difference	No Ebola	Ebola Cases	difference
SLIHS 2011	0.4402	0.6600	0.2398	0.3403	0.4235	0.0832
	(0.0011)	(0.0076)	(0.0072)	(0.0097)	(0.0073)	(0.0123)
SLIHS 2018:	0.3221	0.6100	0.2879	0.4683	0.6605	0.1921
	(0.0079)	(0.0076)	(0.0120)	(0.0071)	(0.0072)	(0.0107)
Raw Diff			**0.0481**			**0.1090**
			(0.0117)			(0.0169)
Samples						
2011: control	2,457			2,457		
Treatment	4,211			4,211		
2018 control	3404			3404		
Treatment	3349			3349		

Source: Author's Own Compilation, SLIHS 2011 and 2018. Standard errors in parenthesis

The information in Table 4 above shows that household objective poverty on average, was higher in for households that were in the chiefdom with confirmed Ebola cases. This is also reflected in terms of food poverty as an average of 42.35% of households in the Ebola confirmed cases chiefdom were below the national food poverty line. The raw differences show some historical differences before the Ebola virus, but they have increased since after the Ebola virus in Sierra Leone. This result also shows that in Table 5, the subjective poverty assessment of households was also high for the Ebola-affected chiefdoms before and after the Ebola crisis. However, food poverty is seen to show an overall reduction in 2018, post-Ebola period. The results in Table 6 below also show the distribution of household expenditure and quantiles across Ebola and Non-Ebola households. Again, there is evidence of mean differences in the trend of household living standards before and after the Ebola impact. There are also such differences in terms of household asset accumulation status and the employment status of household heads. Though the statistics are just

raw differences without indicating any form of causation, it show that the trends across standards of living in Sierra Leone after the Ebola virus have a negative correlation.

Table 5: The Raw Statistical Differences in mean for Subjective poverty by Ebola Confirmed Cases in chiefdoms

Subjective Poverty						
Years	**poor**			**Food**		
	Non-Ebola	Ebola	Diff	Non-Ebola	Ebola	Diff
SLIHS 2011	0.531	0.6147	0.0837	0.6534	0.7288	0.0754
	(0.0101)	(0.0075)	(0.0125)	(0.0096)	(0.0069)	(0.0116)
SLIHS 2018	0.4106	0.6472	0.2366	0.5301	0.5605	0.0304
	(0.0084)	(0.0083)	(0.0118)	(0.0086)	(0.0086)	(0.0121)
Raw diff			**0.1529**			**-0.045**
			(0.0172)			**(0.0168)**
Samples						
2011: control	2,457			2,457		
Treatment	4,211			4,211		
2018: control	3,387			3,387		
Treatment	3,336			3,336		

Source: Author's Own Compilation, SLIHS 2011 and 2018. Standard errors in parenthesis

Table 6: Descriptive Summary Statistics of household expenditure categories by Ebola Confirmed Cases

	SLIHS 2011			**SLIHS 2018**		
Variable	Overall	Ebola	Non-Ebola	Overall	Ebola	Non-Ebola
Welfare indicators:						
Log of household exp	15.8334	15.9262	15.6191	19.0904	18.9129	19.2651
	(0.0031)	(0.0128)	(0.0087)	(0.0074)	(0.0094)	(0.0104)
Log of food exp	15.3159	15.1607	15.9262	18.2552	18.0721	18.4354
	(0.0028)	(0.0089)	(0.0128)	(0.0028)	(0.0104)	(0.0105)
Expenditure Quantiles						
10^{th}	15.0067	14.9432	15.1971	18.3676	18.2504	18.5525
	(0.0132)	(0.0158)	(0.0205)	(0 .0100)	(0.0073)	(0.0147)
25^{th}	15.3438	15.2614	15.5223	18.6629	18.5472	18.8403
	(0.0092)	(0.0110)	(0.0138)	(0.0077)	(0.0107)	(0.0104)
50^{th}	15.7125	15.6103	15.8963	19.0694	18.8798	19.2148
	(0.0089)	(0.0105)	(0.0150)	(0.0075)	(0.0104)	(0.0146)
75^{th}	16.1089	15.9747	16.3438	19.4891	19.2222	19.6183
	(0.0107)	(0.0113)	(0.0192)	(0.0134)	(0.0117)	(0.0039)
90^{th}	16.5215	16.3311	16.7302	19.8369	19.6117	20.0110
	(0.0159)	(0.0163)	(0.0204)	(0 .0187)	(0.0214)	(0.0342)
Total exp	0.3349	0.3354	0.3511	0.3599	0.3331	0.3863
	(0.0014)	(0.0030)	(0.0061)	(0.0065)	(0.0037)	(0.0123)
Food exp	0.2931	0.3028	0.3090	0.3249	0.3288	0.32092
	(0.0014)	(0.0031)	(0.0063)	(0.0030)	(0.0032)	(0.0050)
Non-food exp	0.4975	0.50661	0.4903	0.4917	0.50441	0.4791
	(0.0017)	(0.0035)	(0.0070)	(0.0055)	(0.0051)	(0.0097)
	0.1020	0.2114	0.1038	0.1520	0.3114	0.1438
Household Assets/savings	(0.0032)	(0.0221)	(0.0235)	(0.0267)	(0.0051)	(0.0031)
	0.1608	0.3555	0.2326	0.0794	0.2791	0.1801
Self-Employ	(0.0116)	(0.0220)	(0.0012)	(0.0034)	(0.0021)	(0.0034)
Farm employed	0.7367	0.3854	0.6072	0.5778	0.2568	0.4160

	(0.1167)	(0.0356)	(0.0234)	(0.0566)	(0.0021)	(0.0311)
	0.0487	0.0863	0.0625	0.1117	0.1322	0.1220
Other	(0.0334)	(0.2667)	(0.0013)	(0.0012)	(0.0034)	(0.0011)

Source: Author's Own Compilation, SLIHS 2011 and 2018. Standard errors in parenthesis

In order to provide a better understanding from the empirical aspect of the analysis, household general characteristics are indicated in Table 7 below. The household age for heads averages around 45 years across the overall sample. There are no significant differences across the confirmed cases of Ebola and non-Ebola chiefdoms. In addition, the household size is relatively around 6 household members per household. The rate of dependency, that is, elderly and children dependent on working age group, is relatively around 2 people per working-age adult. The gender composition shows higher male household heads though slightly higher for female heads in the Ebola-affected chiefdoms before and after the Ebola outbreak.

Table 7: Household Summary Statistics of characteristics by Ebola Confirmation Status across the Years

Variable	2011 Ebola	Non-ebola	Overall	2018 Ebola	Non-ebola	Overall
Household characteristics:						
Head's age	45.9610	44.8006	45.5334	47.7935	46.3906	47.0867
	(14.3147)	(13.9312)	(14.1846)	(14.7784)	(14.3011)	(14.5558)
Household size	5.6246	5.4599	5.5639	7.1135	7.1337	7.1236
	(2.3646)	(2.5866)	(2.4499)	(3.2867)	(3.1005)	(3.1940)
Dependency ratio	1.1052	1.1542	1.1233	1.6466	1.8657	1.7571
	(1.0593)	(1.1960)	(1.1118)	(1.0346)	(1.1453)	(1.0972)
Female head	0.2448	0.2808	0.2581	0.2719	1.8657	0.2630
Male head	0.7552	0.7192	0.7876	0.7281	(1.1453)	0.7370
Head's education:						
No education	0.7364	0.5267	0.6591	0.6532	0.4894	0.5242
Primary	0.0674	0.0977	0.0786	0.0995	0.3856	0.1409
Secondary	0.1306	0.2495	0.1744	0.1655	0.4405	0.2148
Higher	0.0544	0.1123	0.0757	0.0818	0.3648	0.1202
Head's Marital status:						
Married	0.8167	0.7379	0.7876	0.6766	0.5391	0.6073
Single	0.0361	0.0749	0.0504	0.2714	0.3875	0.3299
Other	0.1387	0.1693	0.1500	0.0149	0.0129	0.0139
Cohabit	0.0085	0.0179	0.0120	0.0039	0.0109	0.0074
Head's religion:						
Christian	0.2223	0.2548	0.2343	0.1132	0.1795	0.1466
Muslin	0.7706	0.7334	0.7569	0.5754	0.5705	0.5729
Other	0.0071	0.0118	0.0088	0.3114	0.2500	0.2805
Regional Indicators:						
Urban	0.2125	0.6109	0.3593	0.3447	0.7470	0.5474
Rural			0.6407	0.6553	0.2530	0.4526
Other household facilities						
Electricity	0.0779	0.2446	0.1393	0.1341	0.4042	0.2703
Durable asset	0.2467	0.3403	0.2812	0.1442	0.1398	0.1420
Number of rooms occupied	3.0798	2.6968	2.9387	3.8723	3.2987	3.5828
	(1.6028)	(1.7152)	(1.6553)	(2.4241)	(1.7204)	(2.0162)
Agric land						
Land size in Acre	1.1174	1.0323	0.8005	0.8631	0.8749	0.8516
	(4.7398)	(4.8894)	(4.4549)	(1.2033)	(1.1986)	(1.2080)
Household components						
Housing characteristics	-0.2711	0.5274	0.0232	0.0727	-0.2485	0.5132
	(1.3110)	(1.5672)	(1.4623)	(1.4905)	(1.1449)	(1.7719)
Amenities characteristics	-0.1508	0.4343	0.0648	0.0143	0.0094	-0.0093
	(1.4296)	(1.5340)	(1.4956)	(1.0888)	(1.6018))	(1.065)

Source: SLIHS, 2011 and 2018, comparable to Sam (2021)

The level of education shows a higher proportion of household heads with no education and is prevalently high for the Ebola-affected areas. Furthermore, the descriptive statistics of household characteristics also show that agriculture is the main employment source across households in Sierra Leone and most heads of households are married. The proportion of Muslim households is higher, and most households are in rural areas.

4.3 Empirical Results- Ebola Impact on Household Living Standards

Table 8: ***The Empirical Pre-Ebola Impact on Objective and Subjective Poverty Status***

	Objective		**Subjective**	
	Poor	Food	Poor	Food
Ebola	0.0701***	0.0338***	-0.0440***	-0.0157
	(0.0125)	(0.0126)	(0.0128)	(0.0126)
Head's age	0.00385*	0.00343	0.00293	-0.000230
	(0.00218)	(0.00225)	(0.00224)	(0.00210)
Primary	0.0240	0.0480	0.0149	-0.0121
	(0.0273)	(0.0299)	(0.0285)	(0.0264)
higher	-0.0160	-0.0470	-0.201***	-0.0478
	(0.0467)	(0.0479)	(0.0473)	(0.0446)
male	0.0379***	0.0397***	-0.0177	0.0171
	(0.0145)	(0.0148)	(0.0147)	(0.0146)
married	-0.0473***	-0.0754***	-0.0147	-0.00746
	(0.0163)	(0.0165)	(0.0170)	(0.0165)
Muslin	-0.00628	-0.0385***	-0.0376***	-0.0476***
	(0.0128)	(0.0135)	(0.0137)	(0.0129)
Agric employed	0.00749	-0.0466**	0.0275	0.0314*
	(0.0179)	(0.0186)	(0.0182)	(0.0177)
Self employed	-0.0528***	-0.0646***	-0.0696***	-0.0965***
	(0.0156)	(0.0158)	(0.0168)	(0.0168)
Dependency ratio	0.00286	0.00217	-0.00481	-0.00238
	(0.00494)	(0.00532)	(0.00510)	(0.00512)
Household size	0.104***	0.0959***	-0.0218***	0.0263***
	(0.00934)	(0.00565)	(0.00677)	(0.00635)
Household size sq	-0.00341***	-0.00184***	8.30e-05	-0.00148***
	(0.000692)	(0.000349)	(0.000462)	(0.000424)

Urban	-0.150***	-0.0645***	-0.0555***	0.0383*
	(0.0198)	(0.0197)	(0.0207)	(0.0198)
Charcoal	-0.117***	-0.0431**	-0.0618***	-0.0127
	(0.0190)	(0.0185)	(0.0204)	(0.0203)
electricity	-0.160***	-0.102***	-0.000722	-0.106***
	(0.0192)	(0.0189)	(0.0212)	(0.0216)
Durable asset	-0.0277**	0.000473	-0.0875***	-0.0335***
	(0.0122)	(0.0132)	(0.0137)	(0.0127)
Rooms	-0.0271***	-0.0385***	-0.00432	-0.0130
	(0.00744)	(0.00730)	(0.00933)	(0.00902)
Rooms sq	0.000906	0.00157**	0.000203	0.00100
	(0.000644)	(0.000611)	(0.000956)	(0.000888)
Housing index	-0.0228***	0.00365	-0.0898***	-0.0539***
	(0.00533)	(0.00553)	(0.00550)	(0.00529)
Amenities index	0.0166***	-0.00593	0.0347***	0.00535
	(0.00468)	(0.00500)	(0.00484)	(0.00456)
primary×urban	-0.0476	-0.0376	-0.00125	0.0379
	(0.0401)	(0.0423)	(0.0438)	(0.0413)
higher×urban	-0.0794	-0.0170	0.00886	-0.141***
	(0.0513)	(0.0530)	(0.0528)	(0.0520)
Constant	0.185***	0.0689	0.771***	0.698***
	(0.0572)	(0.0571)	(0.0582)	(0.0550)
Observations	6,574	6,574	6,574	6,574
R-squared	0.245	0.138	0.153	0.092

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The empirical results firstly derived from the linear probability regressions for the data in 2011 Sierra Leone integrated Survey is shown in Table 8 below. The results show that after controlling

for household characteristics, the households in the Ebola-affected chiefdoms saw an increase in the probability of being below the objective poverty line by 7 percentage points. The result is also similar for objective food poverty, as the probability stood around 3.3 percentage points before the Ebola outbreak. However, the result also shows that household subjective poverty and food poverty had a reduction in probability before the Ebola Outbreak.

The result from the 2018 SLIHS presented in Table 9 below shows that households in the Ebola confirmed cases region indicate a positive probability of being poor for both subjective and objective poverty. The household indicates 5.5 percentage point to be below the poverty line and the 3.0 percentage point to be below the food poverty line. Most importantly, the households in the quarantine chiefdoms also show a higher probability of 6.2 and 3.8 percentage point likelihood to be poor and food insecure objectively.

Table 9: ***The Empirical Post-Ebola Impact on Objective Poverty Status***

	Ebola Cases		**Ebola Quarantine**	
VARIABLES	poor	Food	poor	Food
Ebola/Quarantine	0.0566***	0.0304**	0.0626***	0.0381***
	(0.0119)	(0.0126)	(0.0125)	(0.0132)
Head's age	0.000988**	0.00239***	0.001000**	0.00241***
	(0.000408)	(0.000426)	(0.000409)	(0.000427)
Male	0.00586	0.197***	0.00365	0.194***
	(0.0195)	(0.0198)	(0.0195)	(0.0198)
Dependency ratio	-0.0174***	-0.0134**	-0.0174***	-0.0134**
	(0.00479)	(0.00556)	(0.00479)	(0.00557)
Primary	-0.00126	-0.124***	-0.001000	-0.123***
	(0.0273)	(0.0287)	(0.0273)	(0.0287)

Secondary	-0.0725**	-0.0551*	-0.0704**	-0.0524*
	(0.0308)	(0.0285)	(0.0307)	(0.0284)
Higher	-0.0556	-0.0948	-0.0587	-0.0987
	(0.0723)	(0.0664)	(0.0722)	(0.0667)
Urban	-0.243***	-0.0311	-0.246***	-0.0355
	(0.0273)	(0.0290)	(0.0274)	(0.0291)
Married	-0.0457***	-0.0112	-0.0458***	-0.0114
	(0.0146)	(0.0153)	(0.0146)	(0.0153)
Muslin	0.0314**	0.0645***	0.0310**	0.0640***
	(0.0131)	(0.0138)	(0.0131)	(0.0137)
Self employed	-0.109***	-0.0305	-0.108***	-0.0297
	(0.0158)	(0.0186)	(0.0158)	(0.0186)
Agric employed	0.0696***	0.0268	0.0700***	0.0273
	(0.0175)	(0.0173)	(0.0175)	(0.0173)
Housing index	-0.0392***	-0.0326***	-0.0393***	-0.0328***
	(0.00383)	(0.00455)	(0.00383)	(0.00456)
Amenities index	0.00871*	0.00751	0.00865*	0.00744
	(0.00505)	(0.00533)	(0.00505)	(0.00533)
Durable asset	0.000576	-0.0133	0.000195	-0.0137
	(0.0149)	(0.0162)	(0.0149)	(0.0162)
Electricity	-0.172***	-0.120***	-0.172***	-0.120***
	(0.0206)	(0.0241)	(0.0206)	(0.0241)
Recharge light	-0.0411**	-0.00597	-0.0403**	-0.00487
	(0.0169)	(0.0187)	(0.0169)	(0.0188)
Land access	0.00824*	0.00305	0.00844*	0.00331
	(0.00448)	(0.00470)	(0.00449)	(0.00471)
married×urban	-0.0316	-0.114***	-0.0312	-0.113***
	(0.0199)	(0.0220)	(0.0199)	(0.0220)
male×urban	-0.00790	-0.316***	-0.00598	-0.314***

	(0.0254)	(0.0280)	(0.0254)	(0.0279)
primary×urban	-0.120***	0.0236	-0.120***	0.0240
	(0.0347)	(0.0375)	(0.0348)	(0.0375)
secondary×urban	0.00993	0.0897**	0.00767	0.0868**
	(0.0361)	(0.0362)	(0.0360)	(0.0361)
higher×urban	-0.0349	0.151**	-0.0321	0.155**
	(0.0759)	(0.0707)	(0.0758)	(0.0710)
Constant	0.668***	0.481***	0.670***	0.483***
	(0.0373)	(0.0387)	(0.0373)	(0.0387)
Observations	6,228	6,228	6,228	6,228
R-squared	0.3357	0.274	0.336	0.274

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 10: ***The Empirical Post-Ebola Impact on Subjective Poverty Status***

	Ebola Cases		**Quarantine**	
VARIABLES	Poor	Food	Poor	Food
Ebola	0.124***	-0.00675	0.114***	-0.00188
	(0.0128)	(0.0139)	(0.0135)	(0.0145)
Head's age	-0.00521***	-0.000652	-0.00523***	-0.000644
	(0.000425)	(0.000460)	(0.000425)	(0.000461)
Male	-0.121***	-0.0840***	-0.117***	-0.0858***
	(0.0196)	(0.0212)	(0.0196)	(0.0212)
Dependency ratio	0.00701	0.0344***	0.00698	0.0345***
	(0.00526)	(0.00634)	(0.00528)	(0.00634)
Primary	-0.101***	-0.194***	-0.101***	-0.194***
	(0.0299)	(0.0322)	(0.0299)	(0.0322)
Secondary	-0.187***	-0.0424	-0.190***	-0.0407
	(0.0347)	(0.0341)	(0.0348)	(0.0341)
Higher	-0.490***	-0.135	-0.485***	-0.138*
	(0.0813)	(0.0829)	(0.0811)	(0.0826)
Urban	-0.127***	0.00430	-0.122***	0.00154
	(0.0262)	(0.0286)	(0.0262)	(0.0287)
married	0.0514***	0.0287	0.0516***	0.0286
	(0.0161)	(0.0177)	(0.0161)	(0.0177)
Muslin	0.0494***	-0.0334**	0.0500***	-0.0337**

	(0.0138)	(0.0154)	(0.0138)	(0.0154)
married×urban	0.0501**	-0.104***	0.0495**	-0.104***
	(0.0219)	(0.0240)	(0.0219)	(0.0240)
male×urban	0.0397	-0.0390	0.0369	-0.0376
	(0.0265)	(0.0289)	(0.0265)	(0.0289)
primary ×urban	-0.0912**	0.227***	-0.0915**	0.227***
	(0.0375)	(0.0405)	(0.0375)	(0.0405)
secondary×urban	0.184***	-0.0235	0.187***	-0.0253
	(0.0406)	(0.0406)	(0.0407)	(0.0407)
higher×urban	0.244***	0.0697	0.240***	0.0719
	(0.0840)	(0.0862)	(0.0838)	(0.0860)
Housing index	-0.0395***	-0.0370***	-0.0393***	-0.0371***
	(0.00412)	(0.00507)	(0.00413)	(0.00507)
Amenities index	-7.78e-05	-0.00254	1.41e-05	-0.00259
	(0.00529)	(0.00585)	(0.00529)	(0.00584)
Durable asset	-0.00386	0.00384	-0.00327	0.00353
	(0.0158)	(0.0174)	(0.0158)	(0.0174)
electricity	-0.187***	0.0731***	-0.187***	0.0731***
	(0.0241)	(0.0267)	(0.0241)	(0.0267)
Recharge light	-0.0695***	0.0347	-0.0709***	0.0354
	(0.0201)	(0.0228)	(0.0200)	(0.0228)
Land access	-0.00111	0.00999*	-0.00143	0.0102**
	(0.00481)	(0.00516)	(0.00481)	(0.00517)
Direct effect			0.0416**	-0.0218
			(0.0182)	(0.0206)
Constant	0.935***	0.589***	0.932***	0.591***
	(0.0379)	(0.0417)	(0.0379)	(0.0418)
Observations	6,228	6,228	6,228	6,228
R-squared	0.210	0.048	0.211	0.048

Source 2011 and 2018 SLIHS, comparable to Sam (2021)

In Table 10 above, the subjective poverty indicators for households in the Ebola confirm cases and the quarantine chiefdoms also show an increase in the probability of poverty. However, there is no significant food insecurity in the quarantine households. In addition, an estimated ordered probit model was also calculated (see Appendix Table A2). The results are consistent with the linear probability estimations. Also, the results from the added data from the Multi-House living standards complement the above.

4.4 Empirical Result- Causal Impact estimation of Ebola on Household Living Standards

The above results from the linear and ordered probit model did not capture the causal impact of Ebola on household living standards. Hence, as indicated in the methodology section, to understand the causal implications, a propensity score matching technique with difference-in-difference estimation was used. This was done after having a balanced covariate between the treated and the control groups covariates, showing no statistical difference (see Appendix Table A3- A5).

Table 11: Average Treatment Effect of Ebola of Household objective and subjective Poverty

	Objective poverty		**Subjective poverty**	
	Poor	food	poor	food
2011	0.0604***	0.0343***	-0.0235	0.0002
	(0.0016)	(0.0016)	(0.0164)	(0.0055)
2018	0.0399***	0.0700***	0.1176***	0.0233
	(0.0015)	(0.0015)	(0.0149)	(0.0155)
DID	-0.0205***	0.0357***	0.1411***	0.0231
	(0.0021)	(0.0059)	(0.0222)	(0.0164)
Samples				
Untreated	2,425	2,457	2,457	2,457
Treated	4,149	4,211	4,211	4,211
Untreated	3,387	3,387	3,387	3,387
Treated	3,336	3,336	3,336	3,336

Note: bootstrapped standard error in parenthesis with 250 replications.

Table 11 above shows the Average Treatment Effect of Ebola on house living standards based on objective and subjective poverty. The results show that household objective poverty is reduced by

((1-e$^{(\beta)}$) x 100%) 2%, but objective food poverty increases by 3.6%. The impact on subjective poverty is higher and stands at 15%. However, subjective food poverty was not significant.

Table 12: Treatment Effect of Ebola and Quarantine on relevant welfare indicators

	Quarantine	**Ebola**
Asset	-0.1170***	-0.0100
	(0.0123)	(0.0150)
Lending	-0.1673**1	-0.0376***
	(0.0123)	(0.0150)
Log total expenditure	-0.0638***	0.0237
	(0.0167)	(0.0196)
Log total food expenditure	-0.0766***	0.0222
	(0.0171)	(0.0202)
Expenditure Gini	-0.0287***	-0.0287***
	(0.0063)	(0.0084)
Expenditure distribution:		
10th	-0.0014	0.1844***
	(0.0471)	(0.0516)
25th	-0.1301***	0.0064
	(0.0204)	(0.0226)
50th	0.0050	0.0593***
	(0.0205)	(0.0235)
75th	-0.1068***	-0.0065
	(0.0219)	(0.0275)
90th	-0.1886***	-0.0379
	(0.0201)	(0.0274)
Samples: Treatment	**2,956**	**3,339**
Control	**3,782**	**3,399**

Bootstrap Standard errors with 500 reps in parentheses

*** p<0.01, ** p<0.05, * p<0.1

The results for the other indicators of standard of living are shown in Table 12 above. The results show that asset accumulation was reduced by 8% due to the Quarantine status, and significant lending capacity was also reduced. Household expenditure was reduced significantly in both Ebola cases and the quarantine policy. In the assessment of the distributional impact, the top end of the household expenditure distribution saw a higher reduction in household expenditure than the lower end of the household distribution. This is very strong for households within the quarantine districts. Hence, the results show a reduction in the general living standards for households affected by the Ebola in Sierra Leone.

4.5 Empirical result- Labour Market Implications of the Ebola Virus and the Rainfall data

The results from the 2018 SLIHS and the 2014 Labour Force survey are presented in Table 13 below. The result shows that employment status shows a significant reduction due to the impact of Ebola. agricultural employment which is a key employment type for households in Sierra Leone

Table 13: Average Treatment Effect of Ebola of Household objective and subjective Poverty

	Ebola		Quarantine	
	Employed	Agric	Employed	Agric
2018 SLIHS	-0.1004***	-0.4243***	-0.0835	-0.0702
	(0.0316)	(0.0116)	(0.0234)	(0.0651)
2014 LFS	-0.0399***	-0.3500***	-0.1176***	-0.0233
	(0.0015)	(0.0015)	(0.0149)	(0.0155)
Samples- 2018 SLIHS				
Untreated	2,425	2,457	2,457	2,457
Treated	4,149	4,211	4,211	4,211

2014 LFS				
Untreated	3,387	3,387	3,387	3,387
Treated	3,336	3,336	3,336	3,336

Note: bootstrapped standard error in parenthesis with 250 replications.

Table 14: Average Treatment Effect of Ebola (Instrument=Rainfall) of Household objective and subjective Poverty

	Ebola=Rainfall		Quarantine= Rainfall	
	Employed	Agric	Employed	Agric
2018 SLIHS	-0.0804***	-0.3243***	-0.0535	-0.0402
	(0.0216)	(0.0116)	(0.0234)	(0.0553)
2014 LFS	-0.0497***	-0.3102***	-0.0972***	-0.019
	(0.0015)	(0.0018)	(0.0123)	(0.0135)
Samples- 2018 SLIHS				
Untreated	2,425	2,457	2,457	2,457
Treated	4,149	4,211	4,211	4,211
2014 LFS				
Untreated	3,387	3,387	3,387	3,387
Treated	3,336	3,336	3,336	3,336

Note: bootstrapped standard error in parenthesis with 250 replications.

The trend increased in the long run, as shown in the 2018 SLIHS. The number of households engaged in agricultural employment is reduced in the short run, and more impact is seen in the long run. The information from the rain precipitation used as an instrument also shows a similar impact, though the magnitude reduces in terms of the labour market implications. Hence, it is clear that the Ebola virus, through the quarantine standards, affects welfare activities like

4.6 Empirical Results- Semi-interview results on the policy around Ebola impact on Household living standards

As indicated in the methodology section, policymakers from the Ministry of Planning and Economic Development (MoPED) were interviewed to understand the implications of Ebola on household living standards. The audio transcript and characteristics are included in the appendix. However, a total of 5 responses were conducted, and the interviews happened within 5mins. The age range is mostly 25-55 years, and education shows achievements at postgraduate levels. The interviews targeted senior policy markers. The answers have been aligned under the two relevant questions.

4.6.1 Q1. What has been the important economic impact of the Ebola in Sierra Leone?

In the interviews, the important economic impact of Ebola stems from the fact that it was an economic shock and one that is not understood across the world. There were both positive and negative implications. The positive stems from the urgency of improving the health system and the creation of more employment opportunities, locally and internationally.

Respondent 1, 3: "*The Ebola was not well understood and the shock impact the economy especially the aspect of investment and the health conditions of vulnerable adults.*"

Respondent 1: "*A positive impact from the Ebola shows the urgency to improve the health system in Sierra Leone. It also created awareness of the country's need around the world".*

Respondent 1: *"There is the implication of new job creation within the health sector, locally and internationally….also there is the efficient allocation of resources."*

Respondent 1: *"The lost of life also implicate the working age especially for people in the rural areas…There is also the total closure from investment and trust in the economy stability…this was serious challenge"*

Respondent 2, 3*: "The negative impact on the economy includes brain drain, low investment, trade restrictions impact Sierra Leone greatly….especially that Sierra Leone is highly dependent on aids and imports"*

Respondent 2, 3: *"Funding was not well utilised during the Ebola as the follow up were not well captured for economic development".*

Respondent 1, 2: *"Social stigma were instil on Sierra Leoneans and this impact the transportation and tourism industry….hence high level of Unemployment and the dependency ratio increases"*

Respondent 3*: "Low productive activities and lack of knowledge in controlling the Ebola"*

Respondent 5, 6: "*What has been the important economic impact of the Ebola in Sierra Leone?*

EVD caused melt down of economic activities as a result of restrictions on movement at the peak of the outbreak. It also resulted in close down of schools, loss of professionals including medical Doctors and Nurses."

4.6.2 Q2. Has there been any policy initiatives from your institution?

In Sierra Leone, the Ebola virus had a greater impact as compared to the other countries, Guinea and Liberia. The institutional policies that were considered includes

Respondent 2, 4: "*Many policies are now in place especially from the health ministry to mitigate outbreak in terms of disease control"*

Respondent 3: *"The Ebola allows for the preventive methods that helps to overcome the impact of Covid-19"*

Respondent 3, 5: *"Cabinet made state level policies like quarantine across chiefdoms and towns—byelaws were put in place"*

Respondent 5,6: *"The 1960 Ordinance on Public Health has changed to National Public Health Agency (NPHA). A structure established as a result of an enactment of the NPHA Act by Parliament, with the mandate to handle disease outbreak preparedness and response."*

5 Chapter 5: Result Discussion

The standard of living trend in Sierra Leone before and after the Ebola outbreak shows an overall reduction in the standard of living. The Ebola outbreak shows that economic shocks that are not well understood can increase the level of poverty status, especially for developing countries. The significant increase in poverty status can increase vulnerability and a cycle of low standard of living. The results are consistent with the literature on the microeconomic implications of disease on micro standard of living (Sam, 2021; Oxfam, 2024; Dumbuya and Nirupama, 2017).

The results also depict interesting findings on food security, household asset accumulation, and the ability to lend and smooth consumption. The households in chiefdom quarantine do have high objective food poverty but subjectively assessed themselves as not food insecure. The policies that were put in place that support quarantine households with food might have provided some explanation on this line. This can also be seen through the reduction in food expenditure. However, the asset accumulation is reduced, and the parameters for borrowing for living standards decrease. The mechanism can also be seen through the negative labour market outcomes and also built up from the semi-structured interviews. The transfer of funds to fight the disease and the closure of productive activities worsen the standard of living. The closure of international borders also impacts investment and capital flow.

In evaluating research hypothesis 1, the empirical results show that the 2014 West African Ebola outbreak significantly negatively impacts household living standards. Hence, the overall economic conditions are a decline in the standard of living in the short and long-run. In the same line,

hypothesis 2 also shows validity that the Ebola impact was more pronounced in chiefdoms with high outbreaks of the virus and prolonged periods of lockdown. Hence, the policy of lockdown and not only the contact of the disease has a major role in the implications of living standards. The results also show that redistribution impact was indicative through the quantiles, with the top-income household losing more. Given that the economic activities of households are mostly in agriculture, the increased death rate and the lack of attendance to agricultural lands and animals increase vulnerability.

In terms of policy implications, the results have provided a critical evaluation and new evidence on the impact of Ebola on household living standards and labour market outcomes. The study's causal interpretation of overall low volume in the standard of living, hence safety nets and economic empowerment, is a key strategy to over long-term trends. The evidence-based policy recommendations for improving living standards in Sierra Leone will be a holistic process of strengthening the health sector and ensuring diversification in skills within the service sector, not just those reliant on agriculture. The financial crisis was mostly due to the non-adaption of certain jobs, and some industries closed, like the tourism and transport industry, which accounts for most non-agricultural jobs. The result has informed on policy around the provision or the mechanisms to combat low living standards, which will provide new insight into developing and implementing social protection and poverty alleviation programs in the country. This strategy is linked to the World Bank (2022) report on the Sierra Leone Poverty Assessment, indicating the poverty trends and development indicators that the country faces in improving the welfare of citizens. The empirical result also informs us of the trends and contextual impact of Ebola on living standards, with the ultimate aim of reducing poverty among the population. Quarantine chiefdoms were already vulnerable, and the health crisis worsened the impact. The aspect of decentralized

governing and using bylaws seems to be effective. Hence, the results further provide a clear understanding of the multidimensional impact of Eboal on the standard of living. Hence, measurements that give a holistic overview of the welfare standards of households and individuals in Sierra Leone are to be mapped against the United Nations Sustainable Development Goals. There is the aspect of building on the multidimensional framework of public health initiatives, economic development policies and social behaviour analysis to give a practical intervention policy for Ebola in Sierra Leone.

6 Chapter 6: Conclusions

The thesis has provided an investigation into the multi-level implications of the Ebola virus on household living standards and labour market outcomes. The thesis explored using three main micro-level data sets: 2011, which predates the Ebola; the 2014 Labour Force Survey; and 2018 SLIHS, which postdates the Ebola period. The living standards indicators include household poverty status (objective and subjective), household expenditure, household savings and asset accumulations, employment status, and type of heads. The national poverty lines were used to understand the implications of poverty. This study is one of the few that have looked at the impact of Ebola in the Manor River region and Sierra Leone. The thesis has gone beyond the household-level impact and also considers the impact of the labour market to show how household living standards can be affected through disease shocks.

The thesis aligns with the theoretical discussion on poverty and reduced income, leading to further vulnerability when assessing standard of living trends within West Africa. The availability of micro-level data on household experiences before, immediately and after the Ebola virus makes the unique empirical evaluation of this thesis causal through propensity score matching and non-traditional difference-in-difference estimation technique. Furthermore, the use of satellite data on rainfall precipitation especially in the agricultural regions, provides an instructed variable approach to validate internally the impact of Ebola on welfare. The data allows for chiefdom-level demarcation, which allows for empirically comparing all the data sets. The data on quarantine and Ebola cases are within the laboratory information from the Ministry of Health, Sierra Leone, and are also allocated at the chiefdom level.

The research has shown that Ebola has negative implications for household living standards in Sierra Leone. The extent of the implication is a further subjection to vulnerability, but it also shows a weaker productive sector and poorer health provision. However, it also creates other mechanisms through which the overall labour market is essentially understanding how households mitigate economic shocks. Government interventions in terms of food supplies show low subjective poverty assessment. Hence, the perception of living standards in developing countries cannot only be understood through objective measures like poverty line, income levels or wage. The standard of living is multidimensional and covers a wide range of subjective assessments and perceptions within communities. The estimation magnitude is comparable across the literature, with poverty increasing by around 2%. Nevertheless, economic shocks from diseases can also have implications for government controls and policies. It cannot be understood on its own terms. Hence, this is a research area that can be developed further. In addition, the Manor River Union also include Guinea and Liberia, hence, comparative data for analysis can also be seen as additional research needs. However, the Ebola impact findings give an understanding of quarantine policy implications in curtailing disease spread. The recent COVID-19 pandemic has shown how an economic downturn can occur, and the Ebola impact was a greater experience from which the world would have learned. Hence, there is a call for a holistic policy approach to disease control and sustainable international guidelines from the Western and developing economies. It is imperative that the status of an economy health system can still fail if economic shocks from disease take place. Hence, micro and macro level approach on improving the standard of living is key. Disease control and vaccination are innovative ways to combat these diseases.

7 Appendices

7.1 Appendix 1

Semi-structure Interview Outlook and Questions

Dear Sir/Madam,

I am Albert Kenneth Bangura-Will, a PhD candidate at Selinus University of Science and Literature, Faculty of Business and Media. This is a semi-structured interview for gaining your professional assessment on the recent Ebola outbreak impact on household standard of living and policies for Sierra Leone as an official within the Health Ministry/Ministry of Economic Development. The interview seeks to generate complementary primary data to understand and discuss the findings in the key areas of my research.

You are kindly asked to complete the questionnaire in the best of your ability, and it won't take more than 10mins of your time. The information you will be providing will aid me in generating the relevant data for my dissertation in completion of my Doctor of Philosophy (PhD) in Economics.

The semi-structure interview will not ask for any personal information and your input will provide me the information needed to complete my PhD thesis in evaluating the implications of the West Africa Ebola on Household Living Standards, evidence for Sierra Leone and in the fulfilment of my degree.

Do You consent to the semi-structure interview?

NO (stop interview)

YES (continues interview)

Best Regards

Albert Kenneth Bangura-Will

Sample Target: Ministry of Health and Ministry of Economic Development Sierra Leone and

Sample: 5 stakeholders

Role within the Ministry: ……

PART A: Demographic Characteristics

1. Please indicate your age category

Age Category	**Response**
18 – 27	
28 – 37	
38 – 47	
48 – 57	
58 and above	

2. Please indicate your sex

Gender	**Response**
Female	
Male	
Do not wish to disclose	

3. Education background

Education Category	**Response**
Undergraduate	
Postgraduate	
Other Graduate degree	
Professional qualification	
Others	

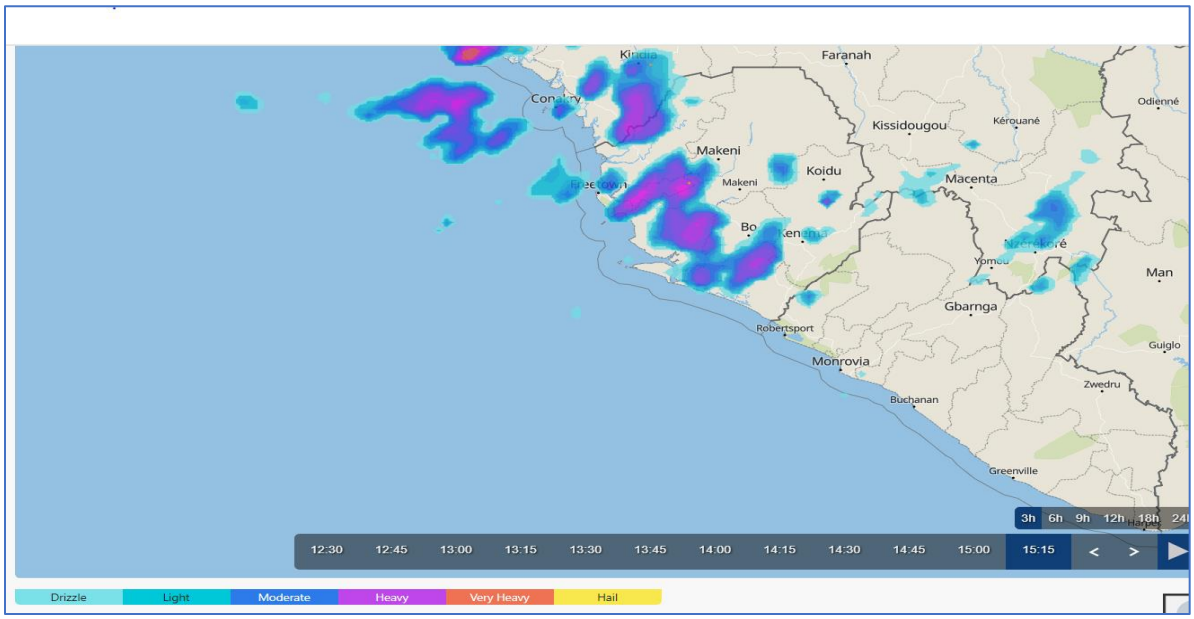
Semi-Structure Interview Questions (Open-ended)- 5mins

Q1. What has been the important economic impact of the Ebola in Sierra Leone?

Q2. Has there been any policy initiatives from your institution?

7.2 Appendix 2

Figure A 1: Sample Display of Rain Precipitation Outlook for Sierra Leone



Source: Satellite Rain Information for Sierra Leone by meteoblue (meteoblue weather display Sierra Leone

Table A 1: Ordered Probit regression on the determinant of Subjective poverty (2011)

VARIABLES	Relative poor	Food security
Ebola	0.144***	0.0422
	(0.0367)	(0.0331)
Head's age	-0.00873	-0.0118**
	(0.00653)	(0.00515)
Primary	-0.0240	0.00753
	(0.0841)	(0.0669)
Higher	0.630***	0.0771
	(0.130)	(0.112)
Male	0.0591	-0.0164
	(0.0422)	(0.0378)
Married	0.0352	-0.00110
	(0.0484)	(0.0427)
Muslin	0.0979**	0.105***
	(0.0389)	(0.0333)
Agric employed	-0.0645	0.0136
	(0.0505)	(0.0437)
Self employed	0.203***	0.201***
	(0.0444)	(0.0427)
Dependency ratio	0.0140	0.00740
	(0.0140)	(0.0132)
Household size	0.0546***	-0.0410**
	(0.0187)	(0.0186)
Household size sq	-0.000430	0.00282**

	(0.00121)	(0.00128)
Urban	0.142**	-0.162***
	(0.0560)	(0.0481)
Charcoal	0.146***	-0.00469
	(0.0517)	(0.0526)
Electricity	0.0717	0.124**
	(0.0543)	(0.0565)
Durable asset	0.228***	0.0577*
	(0.0360)	(0.0328)
Rooms	0.0323	0.0106
	(0.0232)	(0.0215)
Rooms sq	-0.000847	-0.00147
	(0.00214)	(0.00204)
Housing index	0.247***	0.167***
	(0.0152)	(0.0128)
Amenities index	-0.0935***	0.0255**
	(0.0142)	(0.0116)
primary×urban	-0.0164	-0.135
	(0.118)	(0.107)
higher×urban	-0.0275	0.299**
	(0.147)	(0.135)
/cut1	0.799***	-1.022***
	(0.165)	(0.138)
/cut2	2.967***	0.267*
	(0.171)	(0.138)
Observations	6,574	6,574

Table A 2: Ordered Probit regression on the determinant of subjective poverty (2018)

	Relative poor	Food security	Relative poor	Food security
Ebola	-0.291***	-0.0131	-0.268***	-0.0162
	(0.0355)	(0.0328)	(0.0376)	(0.0344)
Head's age	0.0138***	0.00273**	0.0138***	0.00272**
	(0.00123)	(0.00109)	(0.00123)	(0.00109)
Male	0.300***	0.0848*	0.290***	0.0859*
	(0.0673)	(0.0463)	(0.0673)	(0.0465)
Dependency ratio	-0.0188	-0.0200	-0.0186	-0.0200
	(0.0153)	(0.0144)	(0.0154)	(0.0144)
Primary	0.278***	0.388***	0.280***	0.388***
	(0.0792)	(0.0857)	(0.0793)	(0.0857)
Secondary	0.591***	0.113	0.600***	0.112
	(0.102)	(0.0792)	(0.102)	(0.0793)
Higher	1.206***	0.251	1.196***	0.253
	(0.201)	(0.261)	(0.201)	(0.261)
Urban	0.266***	-0.0518	0.251***	-0.0501
	(0.0819)	(0.0629)	(0.0820)	(0.0632)
married	-0.123***	0.00364	-0.123***	0.00367
	(0.0460)	(0.0431)	(0.0460)	(0.0431)
Muslin	-0.100**	0.147***	-0.101**	0.147***

	(0.0401)	(0.0369)	(0.0401)	(0.0369)
married×urban	-0.118*	0.191***	-0.117*	0.191***
	(0.0612)	(0.0597)	(0.0612)	(0.0597)
male×urban	-0.0113	0.0794	-0.00250	0.0785
	(0.0814)	(0.0644)	(0.0814)	(0.0645)
primary ×urban	0.166*	-0.356***	0.166*	-0.356***
	(0.0968)	(0.103)	(0.0969)	(0.103)
secondary×urban	-0.559***	0.140	-0.568***	0.141
	(0.116)	(0.0954)	(0.117)	(0.0956)
higher×urban	-0.454**	-0.0822	-0.445**	-0.0838
	(0.208)	(0.268)	(0.208)	(0.267)
Housing index	0.150***	0.0389***	0.150***	0.0389***
	(0.0125)	(0.0135)	(0.0125)	(0.0135)
Amenities index	-0.00101	0.00427	-0.00118	0.00429
	(0.0150)	(0.0137)	(0.0150)	(0.0137)
Durable asset	-0.0161	0.0115	-0.0174	0.0117
	(0.0447)	(0.0406)	(0.0447)	(0.0406)
electricity	0.527***	0.155**	0.528***	0.155**
	(0.0679)	(0.0742)	(0.0678)	(0.0742)
Recharge light	0.288***	0.231***	0.292***	0.231***
	(0.0601)	(0.0645)	(0.0599)	(0.0645)
Land access	0.00271	-0.0136	0.00346	-0.0138
	(0.0137)	(0.0120)	(0.0137)	(0.0120)
Direct effect			-0.107*	0.0140
			(0.0597)	(0.0478)
/cut1	1.261***	-0.549***	1.252***	-0.548***
	(0.117)	(0.107)	(0.118)	(0.107)
/cut2	3.622***	0.654***	3.613***	0.655***
	(0.136)	(0.106)	(0.136)	(0.106)
Observations	6,213	6,228	6,213	6,228

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table A 3: Covariate mean and variance by treatment and control group (2011)

Variable	Treated	Control	%bias	T	p>t	V_e(C)
Head's age	47.79	47.36	3.00	1.21	0.23	1.01
Age sq	2502.60	2446.20	3.80	1.54	0.12	1.04
male	0.73	0.74	-1.80	-0.72	0.47	1.00
Dependency ratio	1.65	1.64	1.40	0.63	0.53	1.11
primary	0.10	0.10	-1.40	-0.67	0.50	0.92
secondary	0.17	0.16	0.90	0.41	0.68	1.01
higher	0.08	0.09	-2.80	-1.33	0.18	0.92
urban	0.34	0.34	1.00	0.40	0.69	1.02
married	0.16	0.15	2.40	0.92	0.36	1.03
christain	0.03	0.03	-0.90	-0.40	0.69	0.95
Housing index	-0.22	-0.21	-1.20	-0.61	0.54	1.02
Housing index sq	1.33	1.29	1.00	0.48	0.64	0.90
Amenities index	0.01	0.04	-2.70	-1.15	0.25	1.09
Durable asset	0.14	0.15	-0.50	-0.18	0.86	1.00
electricity	0.13	0.13	0.40	0.20	0.84	1.02
Recharge light	0.78	0.78	-0.40	-0.18	0.86	1.02
Self employed	0.08	0.08	0.50	0.26	0.80	1.03
charcoal	0.18	0.18	0.50	0.24	0.81	1.03
male× urban	0.25	0.25	1.20	0.52	0.60	1.03
primary ×urban	0.04	0.04	1.10	0.62	0.54	1.14
secondary×urban	0.11	0.10	1.50	0.74	0.46	1.04

* if 'of concern', i.e. variance ratio in [0.5, 0.8) or (1.25, 2]

** if 'bad', i.e. variance ratio <0.5 or >2

Table A 4: Covariate mean and variance by treatment and control group (2018)

Variable	Treated	Control	%bias	t	p>t	V_e(C)
Head's age	45.90	46.36	-3.30	-1.46	0.14	0.97
Age sq	2310.70	2355.10	-3.10	-1.36	0.17	0.96
primary	0.07	0.07	0.60	0.31	0.76	1.02
higher	0.05	0.06	-1.40	-0.73	0.46	0.92
male	0.75	0.74	2.70	1.23	0.22	0.95
single	0.04	0.04	-1.60	-0.87	0.39	0.91
Self employed	0.16	0.17	-2.00	-1.03	0.30	0.93
Dependency ratio	1.10	1.08	1.90	0.94	0.35	1.01
Household size	5.63	5.56	2.70	1.27	0.20	0.98
Household size sq	37.26	36.54	2.00	1.03	0.30	1.15
urban	0.21	0.21	0.20	0.12	0.91	1.01
charcoal	0.09	0.10	-2.30	-1.39	0.16	0.88
electricity	0.08	0.09	-2.70	-1.62	0.11	0.84
Durable asset	0.25	0.26	-1.90	-0.90	0.37	0.98
Housing index	-0.27	-0.27	-0.30	-0.14	0.89	0.87
Amenities index	-0.16	-0.14	-1.10	-0.49	0.62	0.95
Primary ×urban	0.02	0.02	0.20	0.12	0.90	1.02
high×urban	0.04	0.04	-0.70	-0.42	0.68	0.94
Housing index×urban	0.19	0.20	-1.30	-0.76	0.45	0.93
Amenities index×urban	0.25	0.25	-1.10	-0.62	0.53	0.90
Electricity ×urban	0.07	0.08	-1.70	-1.06	0.29	0.87
Dependency sq	2.34	2.25	1.40	0.72	0.47	1.08
dependency×urban	0.24	0.24	0.00	-0.01	1.00	0.99
male×urban	0.15	0.15	0.60	0.32	0.75	1.02
Self employed×urban	0.08	0.09	-0.50	-0.32	0.75	0.97

* if 'of concern', i.e. variance ratio in [0.5, 0.8) or (1.25, 2]

** if 'bad', i.e. variance ratio <0.5 or >2

Table A 5: Balancing diagnostic of the propensity score

2011	Ps R2	LR chi2	p>chi2	MeanBias	MedBias	B	R	%concern	%bad
Unmatched	0.17	1607.43	0.00	31.90	24.80	107.2*	0.80	50.00	23.00
Matched	0.00	20.40	0.56	1.50	1.20	11.10	1.22	0.00	0.00
2018									
Unmatched	0.16	1393.21	0.00	34.70	26.20	102.5*	0.69	24.00	44.00
Matched	0.00	19.54	0.77	1.50	1.40	9.70	1.07	0.00	0.00

* if B>25%, R outside [0.5; 2]

Table A 6: Poverty lines and rates for 2011 and 2018 in thousands of leones

	Food Poverty line	**Non-food poverty line**	**Total poverty line**	**Food poverty rate**	**Total poverty rate**
2018 main	2125	1796	3921	54.5%	56.8%
2018 comparable	1960	1708	3668	54.5%	56.8%
2011 comparable	963	931	1894	46.1%	62.4%
2011 main	925	701	1626	47.7%	52.9%

Source: SLIHS 2018 methodology for consumption-poverty estimation, adapted from Sam (2021)

8 Appendix 3

8.1 Semi-Structure Interview Respondents Details

Respondent 1

Role within the Ministry: Senior Economist, Ministry of Planning and Economic Development (MoPED)

PART A: Demographic Characteristics

1. Please indicate your age category

Age Category	**Response**
18 – 27	
28 – 37	
38 – 47	X
48 – 57	
58 and above	

2. Please indicate your sex

Gender	**Response**
Female	
Male	Male

Do not wish to disclose	

3. Education background

Education Category	**Response**
Undergraduate	BSc Economics
Postgraduate	M.Sc Development Economics
Other Graduate degree	
Professional qualification	
Others	

Semi-Structure Interview Questions (Open-ended)- 5mins

Q1. What has been the important economic impact of the Ebola in Sierra Leone?

Response in audio 1 & 2 recordings

Q2. Has there been any policy initiatives from your institution?

Yes. Response in audio 1 & 2 recordings

Respondent 2

Role within the Ministry: Deputy Development Secretary, Ministry Planning and Economic Development (Moped)

PART A: Demographic Characteristics

1. Please indicate your age category

Age Category	**Response**
18 – 27	
28 – 37	
38 – 47	
48 – 57	X
58 and above	

2. Please indicate your sex

Gender	**Response**
Female	
Male	Male
Do not wish to disclose	

3. Education background

Education Category	**Response**
Undergraduate	BA. History and Politics
Postgraduate	MA Economic Policy

Other Graduate degree	
Professional qualification	Member, Project Management Institute
Others	

Semi-Structure Interview Questions (Open-ended)- 5mins

Q1. What has been the important economic impact of the Ebola in Sierra Leone?

Response in Audio 3 & 4 recordings

Q2. Has there been any policy initiatives from your institution?

Yes. Response in Audio 3 & 4 recordings

Respondent 3

Role within the Ministry: Planning Officer

PART A: Demographic Characteristics

1. Please indicate your age category

Age Category	**Response**
18 – 27	
28 – 37	
38 – 47	X
48 – 57	yes

58 and above	

2. Please indicate your sex

Gender	**Response**
Female	
Male	Male
Do not wish to disclose	

3. Education background

Education Category	**Response**
Undergraduate	B.Sc Information Technology
Postgraduate	Master in Public Administration
Other Graduate degree	
Professional qualification	
Others	

Semi-Structure Interview Questions (Open-ended)- 5mins

Q1. What has been the important economic impact of the Ebola in Sierra Leone?

Response in Audio 5 recording

Q2. Has there been any policy initiatives from your institution?

Yes. **Response in Audio 5 recording**

Respondent 4

Role within the Ministry: Community Health Officer

PART A: Demographic Characteristics

1. Please indicate your age category

Age Category	**Response**
18 – 27	
28 – 37	
38 – 47	
48 – 57	X
58 and above	

2. Please indicate your sex

Gender	**Response**
Female	
Male	Male
Do not wish to disclose	

3. Education background

Education Category	**Response**
Undergraduate	Diploma and Bachelor of Medicine
Postgraduate	
Other Graduate degree	
Professional qualification	Member of International Professionals for Community Health
Others	

Semi-Structure Interview Questions (Open-ended)- 5mins

Q1. What has been the important economic impact of the Ebola in Sierra Leone?

Response in Audio 6 recording

Q2. Has there been any policy **initiatives from your institution?**

Yes. Response in Audio 6

The 1960 Ordinance on Public Health has changed to National Public Health Agency (NPHA).A structure established as a result of an enactment of the NPHA Act by Parliament, with the mandate to handle disease outbreak preparedness and response.

Respondent 5

Role within the Ministry: Medical Doctor

PART A: Demographic Characteristics

1. Please indicate your age category

Age Category	**Response**
18 – 27	
28 – 37	
38 – 47	
48 – 57	yes
58 and above	

2. Please indicate your sex

Gender	**Response**
Female	
Male	Male
Do not wish to disclose	

3. Education background

Education Category	**Response**
Undergraduate	MD
Postgraduate	MPH

Other Graduate degree	
Professional qualification	Medical Doctor
Others	Senior Public Health Specialist

Semi-Structure Interview Questions (Open-ended)- 5mins

Q1. What has been the important economic impact of the Ebola in Sierra Leone?

EVD caused melt down of economic activities as a result of restrictions on movement at the peak of the outbreak. It also resulted in close down of schools, loss of professionals including medical Doctors and Nurses.

Q2. Has there been any policy initiatives from your institution?

Yes.

The 1960 Ordinance on Public Health has changed to National Public Health Agency (NPHA).A structure established as a result of an enactment of the NPHA Act by Parliament, with the mandate to handle disease outbreak preparedness and response.

Respondent 6:

Role within the Ministry: Medical Doctor

PART A: Demographic Characteristics

1. Please indicate your age category

Age Category	**Response**

18 – 27	
28 – 37	
38 – 47	
48 – 57	yes
58 and above	

2. Please indicate your sex

Gender	**Response**
Female	
Male	Male
Do not wish to disclose	

3. Education background

Education Category	**Response**
Undergraduate	MD
Postgraduate	MPH
Other Graduate degree	
Professional qualification	Medical Doctor
Others	Senior Public Health Specialist

Semi-Structure Interview Questions (Open-ended)- 5mins

Q1. What has been the important economic impact of the Ebola in Sierra Leone?

EVD caused melt down of economic activities as a result of restrictions on movement at the peak of the outbreak. It also resulted in close down of schools, loss of professionals including medical Doctors and Nurses.

Q2. Has there been any policy initiatives from your institution?

Yes.

The 1960 Ordinance on Public Health has changed to National Public Health Agency (NPHA).A structure established as a result of an enactment of the NPHA Act by Parliament, with the mandate to handle disease outbreak preparedness and response.

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