Fighting Hunger Worldwide

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Food insecurity on the rise as Ebola abates

Application of Shock Impact Simulation Model (SISMod) to measure Ebola's economic impacts on hunger

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For additional information, please contact:

Economic and Market Analysis Unit wfp.economicanalysis@wfp.org

Chloe Wong, Economist, Statistician chloe.wong@wfp.org

Valerio Giuffrida, Statistician valerio.giuffrida@wfp.org

Tobias Flämig, Head of Economic and Market Analysis Unit tobias.flaemig@wfp.org

Arif Husain, Chief Economist & Deputy Director Policy and Programme Division arif.husain@wfp.org

Executive Summary

From health crisis to economic and food crisis

Since March 2014, Ebola has swept West Africa. Although this unprecedented epidemic has been slowing down – Liberia was declared Ebola-free in May 2015 – its impact continues to be felt not only as a health crisis, but also as an economic crisis that is severely hampering already fragile economies. The focus of responses is shifting from ending the epidemic to rebuilding the countries. However, the fight against Ebola is far from over as the disease continues to affect household livelihoods and food security through its adverse impacts on the economy.

Shock Impact Simulation Model (SISMod)

Estimates of the economic impact of Ebola on household food security are needed to develop response scenarios. In the view of this, the Food Security Analysis and Trends Service (VAM) of the World Food Programme (WFP) has developed a 'light version' of the Shock Impact Simulation Model (SISMod-Light), an economic modelling system. This will provide early quantitative estimates of food insecurity for the current situation as well as anticipated scenarios in the near future, particularly for the coming lean season.

Most likely scenarios: economic slow-down and food price increases in 2015

Based on secondary data available at the time of writing, the two most likely scenarios have been created representing the first half and the third quarter of 2015, based on the following assumptions: a modest decrease in 2014/2015 national food production with disparities at subnational levels; decreasing household income and relatively stable food prices in the first half of 2015; and significant food price increases in the lean season of the third quarter of 2015. These shocks are factored in the model as the input parameters of the simulation.

One-in-four could be food insecure in the 2015 lean season

The three Ebola-stricken countries have a combined population of 23 million. It is estimated that economic slowdown could leave 3.66 million people food insecure (16%) in the first half of 2015. The number of food insecure could increase to 6.24 million (27%) during the lean season in the third quarter of 2015, under the assumptions of continuing economic slowdown and seasonal high food prices. The impact is particularly pronounced among poor households who live in rural areas and mostly rely on agriculture. The minimum food shortfall is estimated at 7,687 mt of cereals a month in the first half of 2015 and 12,949 mt of cereals a month during the next lean season.

Table of Contents

Tables

Figures

Appendices

Acknowledgements

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Acronyms

APC	Average Propensity to Consume
CFSAM	Crop and Food Security Assessment
CFSVA	Comprehensive Food Security and Vulnerability Analysis Survey
CPI	Consumer Price Index
DET	Dietary Energy Threshold
FAO	Food and Agriculture Organization
FCS	Food Consumption Score
GDP	Gross Domestic Product
GIEWS	Global Information and Early Warning System of the Food and Agriculture Organization
LAIDS	Linear Almost Ideal Demand System
LES	Linear Expenditure System
SISMod	Shock Impact Simulation Model
SISMod-Light	Light version of Shock Impact Simulation Model
SUR	Seemingly Unrelated Regression
VAM	Food Security Analysis and Trends Service of the World Food Programme
WFP	World Food Programme
WHO	World Health Organization

1 Introduction

The 2014 Ebola epidemic began in March, and the virus spread rapidly in West Africa. This unprecedented outbreak compelled the World Health Organization (WHO) to declare a "Public Health Emergency of International Concern" on 8 August 2014. Fourteen months later,[1] Ebola has infected 26,933 people and killed 11,120 people in the worst-hit nations of Guinea, Sierra Leone and Liberia (WHO, 2015). Guinea and Sierra Leone are still reporting new cases; Liberia was declared Ebola-free by WHO on 9 May 2015 after 42 days of no new cases.

Although the epidemic has been slowing down, its impact continues to escalate not only as a health crisis, but also as an economic crisis that has severely hampered the fragile economies of the countries affected. Measures to control Ebola and fears about the disease drastically reduced the movement of people and work activities (FEWS NET, 2014). This has led to lost income, food shortages and price hikes which are exacerbating food insecurity and causing a food crisis (European Commission - Joint Research Centre, 2015). Reports analysing mVAM [2] phone surveys and data collection have shown that households are adopting negative coping strategies (WFP, 2015). Similarly, trader reports by FEWS NET have highlighted reduced market supplies of main commodities and the complete closure of some markets (FEWS NET, 2015). World Bank projections show a possible $1.6 billion loss, equal to 12 percent of the combined GDP of the three countries in 2015 (World Bank, 2015). The effects of Ebola reach far beyond the immediate outbreak and can have consequences for the economy and food security of the affected nations, and even of the wider region.

Relief and development efforts must focus not only on those directly affected by Ebola, but also on poor communities who are vulnerable and less able to cope with the economic side effects of the disease. Estimates of the direct and indirect impacts of Ebola on household food security are needed to develop response scenarios. That is why WFP's Food Security Analysis and Trends Service (VAM) has developed a 'light version' of the Shock Impact Simulation Model[3] (SISMod-Light), an economic modelling system, to allow early quantitative assessments before field assessments can be carried out in the quarantined areas.

This paper presents VAM's estimates of the impact of Ebola on household food security in Guinea, Sierra Leone and Liberia based on the possible trends of economic and market factors that affect household income, expenditure and food consumption. The main focus is to provide insights into potential food security developments in 2015. The paper starts by presenting the methodology of SISMod-Light. It then presents two scenarios per country: hypothetical economic slowdown scenarios for the first half of 2015 (H1-2015) and for the lean season in the third quarter of 2015 (Q3-2015). The conclusions are presented in the last section of the report.

[1] Figures from 20 May 2015.

[2] WFP initiated the mobile Vulnerability Analysis and Mapping (mVAM) to collect food security data using remote mobile surveys through interactive voice response (IVR) system, live call and text message (SMS).

[3] The Shock Impact Simulation Model (SISMod) requires enormous data, with approximately one thousand variables, considering the complexity of its multi-stages approach. Because of time and data constraints, a light, less data-intensive version has been developed and applied for this paper. An in-depth description of the original SISMod can be found in *Food Price Volatility and Natural Hazards in Pakistan* (FAO and WFP 2014), available at http://www.fao.org/3/a-i3808e.pdf

2 Approach

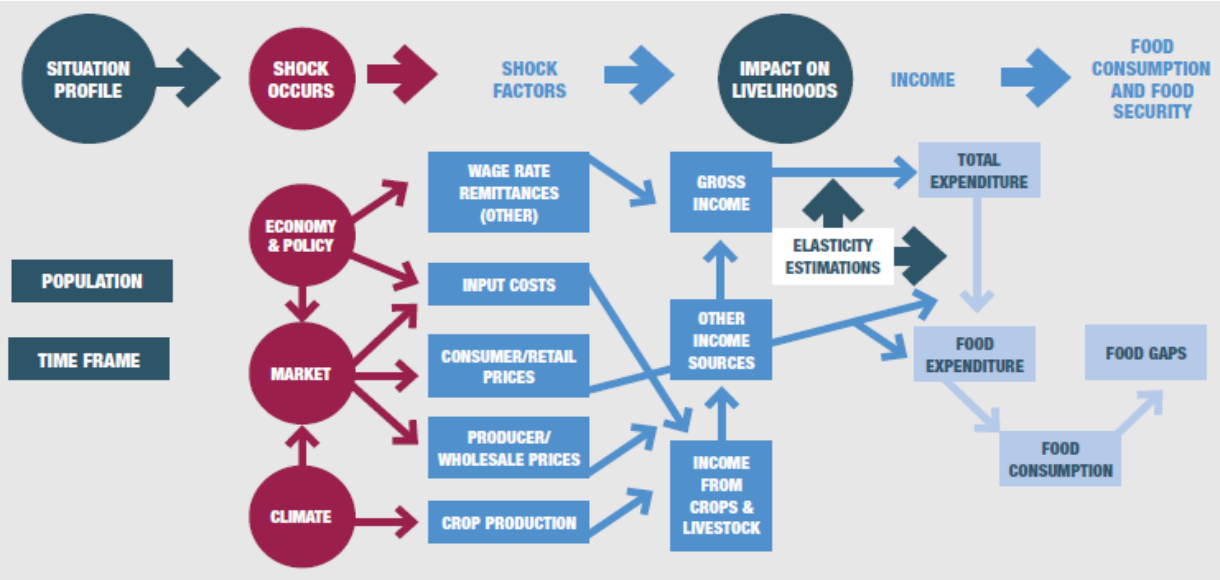
SISMod-Light is designed to estimate the economic impacts of Ebola on household food security for the current situation and anticipated scenarios in the near future.

2.1 SISMod-Light

VAM and the Global Information and Early Warning System (GIEWS) of the Food and Agriculture Organization (FAO) began a joint project in 2009 to develop the Shock Impact Simulation Model (SISMod) to monitor food security situation in low-income food deficit countries. A comprehensive set of results for SISMod was published in the book *Food Price Volatility and Natural Hazards in Pakistan* (FAO and WFP, 2014).

SISMod is an economic model based on the Agricultural Household Model (Singh, Squire, & Strauss, 1986). It comprises a series of modules that take into account household income, expenditure and food consumption. The process determines the interaction between production and income-generation decisions (income effects) and consumption decisions (price effects), which quantify the impacts of price changes and income changes on household food consumption. Figure 1 provides a simple schematic description of the model framework.

Figure 1. SISMod Framework



SISMod requires comprehensive baseline data from national household surveys, e.g. Living Standards Measurement Study surveys and Household Income and Expenditure Surveys. However, because of data and time constraints, smaller sets of household data from Comprehensive Food Security and Vulnerability Analysis (CFSVA) surveys have been used to develop SISMod-Light. Both SISMod and SISMod-Light use the same methodology. The main difference between them is the amount of data used and their level of detail. CFSVA data needs special treatment to extract the minimum data required. For example, we converted the CFSVA semi-quantitative food frequency questionnaire data into energy intake in kilocalories.

SISMod-Light greatly reduces the implementation time and the dependency on very detailed baseline data from national household surveys, as well as the need for economic and market trend data which are usually not available in an emergency. Although the degree of detail is limited, SISMod-Light can provide useful insights into the impact of shocks on household food security. This study used 2012 CFSVA data for Guinea and 2010 data for Liberia and Sierra Leone.[4]

2.2 Conceptual Underpinnings: Agricultural Household Model

Like SISMod, SISMod-Light adopts the Agricultural Household Model approach developed by Singh et al. (1986). In this model, household consumption decisions are based on household income, which comprises agricultural profits as well as wages, remittances and any other type of income. Income generation and the allocation of income to expenditure are based on separable decisions, which maximize income and utility in a two-step process. The Agricultural Household Model incorporates both household production and consumption. It integrates price effects – which are presumed to be exogenous – and takes interactions between them into account.

Unlike in pure consumer models, in the Agricultural Household Model the household budget is not fixed but endogenous and depends on production decisions that contribute to income through agricultural profits. This implies that the additional effects of agricultural profits, which can be simultaneously positive and negative, are added to the standard Slutsky equation[5] (Taylor, 2003). For example, an increase in the price of staples unleashes to two opposing forces: the traditional price effects (where household food demand decreases when the price rises), and the opposing effect of agricultural profits (which, by contributing to household total income, lift budget constraints thereby increasing household food demand). Therefore, a change in price of a given commodity affects both supply and demand decisions.

2.3 Pass-through of Shock: The Income Generation Module

The income generation module (equation 1) is used to link shocks to household income (I_b), which is disaggregated into the following categories: net agricultural income (value of total crop and livestock production by type [subscript "c"], i.e. price [P_c] times quantity [A_c] minus total input cost [C]), wage income (W), enterprise income (E), remittance (R) and other income (O):

$$I_b = \left(\sum_c P_c A_c - C\right) + W + E + R + O \quad (1)$$

Each income category is subject to different shocks directly and indirectly. Shock in the model refers to a quantity change from the baseline. Quantity changes in monitored data from different sources such as food prices (SP_c), crop production data (SA_c) and other economic indicators, such as GDP (S_{GDP}),

[4] These are nationally representative sample surveys. The number of households interviewed was 4,330 for Guinea, 13,700 for Liberia, and 4,880 for Sierra Leone.

[5] The Slutsky equation was developed by Eugen Slutsky (1880–1948). It demonstrates that the change in demand caused by a price change is the result of a substitution effect and an income effect.

national remittance inflow (S_R) and national average wage rate (S_W) are used to derive the shock factors, which are expressed as ratio. The shock factors of components not linked to available monitored data are set equal to 1, i.e. assuming no change from the baseline. Thus, the income generation module estimates new income I_s in the shock year by applying the shock factors onto the baseline:

$$(2) \qquad I_s = (\sum_c P_c\, SP_c A_c SA_c - C) + WS_W + ES_{GDP} + RS_R + O$$

2.4 Budget Allocation: Two-Stage Demand System

Average Propensity to Consume

To pass the shocks from household income to household expenditure, the average propensity to consume (APC) is used. APC is defined as the ratio of total household spending to total disposable income (Keynes, 1936). Kuznets later proved that APC is approximately mean-reverted, such that consumption keeps almost a stable fraction of income in long-run time series disregarding the magnitude of change in income (Kuznets, 1946). The equation for total expenditure (Y_s) is specified as a function of total household income after shock (I_s), controlling for the social and demographic characteristics of households (D) such as size, location, gender of household head and education level of household head:

$$(3) \qquad Y_s = f(I_s\,, D)$$

The derived elasticities are used in the model.

First Stage Demand System (Linear Expenditure System)

The first stage of the demand system models consumption decisions by allocating total expenditure to broad commodity groups. For example, from the CFSVA data, the broad commodity groups include food, clothing, utilities, housing, transport, communication, and personal and health care. A Seemingly Unrelated Regression is used to estimate a Linear Expenditure System (LES) for the first stage of the demand system. LES is a widely used traditional approach functional form derived from maximization of the utility function subject to the expenditure restriction. It was derived by Stone (1954) and expressed as:

$$(4) \qquad P_I X_I = P_I R_I + \beta_I \left[Y_s - \sum_j P_j\, R_j \right]$$

with $0 < \beta_I < 1$, $\sum_I \beta_I = 1$, and $Y_s > X_I$. Where $P_I X_I$ is the expenditure of a commodity group (P_I and X_I are aggregated price and quantity indices for commodities within group I), and R_I and β_I are the parameters. More precisely, R_I is the minimum (subsistence) quantity demanded of commodity group I and β_I is a fraction of the supernumerary expenditure which is the remaining budget after subsistence of all commodity groups has been achieved. Y_s is the household total expenditure after shock derived from the APC in the earlier stage. The uncompensated own-price and cross-price elasticities associated with equation (4) are respectively:

$$(4.1) \qquad \eta_{II} = (1 - \beta_I)\, P_I R_I / P_I X_I \; - 1$$

(4.2) $$\eta_{IJ} = (-\beta_I)P_j R_j / P_I X_I - 1$$

and the expenditure elasticities are:

(4.3) $$\mu_I = \beta_I \, Y_s / (P_I X_I) \, .$$

Second Stage Demand System (Linear Almost Ideal Demand System)

In the second stage, a Linear Almost Ideal Demand System (LAIDS) (Deaton, 1986) is estimated for the food groups such as rice, cassava, other cereals, pulses, vegetables and fruits, meat, eggs and dairy products, sugar and oils. LAIDS models consumption decisions by allocating food expenditure to food groups. Each equation in LAIDS is given by:

(5) $$w_i = \alpha_{i0} + \sum_k \alpha_{ik} D_k + \sum_j \gamma_{ij} \ln P_j + \beta_i \ln\left(\frac{X}{P}\right) + \varepsilon_i$$

where w_i is the budget share of the i^{th} food group, α are parameters, ε_i is the residual, D_k is a set of the household social and demographic characteristics, P_j is price of the j^{th} food group, X is the total expenditure on all goods in the system and P is the price index defined by Stone's index. The index is widely used for LAIDS estimations (Asche, 1997) and it is expressed as:

(5.1) $$\ln P = \sum_i w_i \ln(P_i)$$

The theoretical restrictions of adding-up, homogeneity and symmetry are imposed in LAIDS by setting respectively:

(5.2) $$\sum_i \alpha_{i0} = 1, \ \sum_j \gamma_{ij} = 0, \ \sum_i \beta_i = 0$$

(5.3) $$\sum_i \gamma_{ij} = 0$$

(5.4) $$\gamma_{ij} = \gamma_{ji}$$

Based on LAIDS, the expenditure elasticity, uncompensated (Marshallian) price elasticities and compensated (Hicksian) price elasticities are calculated as follows:

(5.5) $$e_i = 1 + \beta_i / \overline{w_i}$$

(5.6) $$e_{ij}^m = -\delta_{ij} + (\gamma_{ij} - \beta_i \overline{w_j}) / \overline{w_i}$$

(5.7) $$e_{ij}^h = -\delta_{ij} + (\gamma_{ij} / \overline{w_i}) + \overline{w_j}$$

Where δ_{ij} is the Kronecker delta, which is unity if $i = j$ (i.e. own-price elasticity) and zero otherwise (i.e. cross-price elasticity); $\overline{w}$ is the sample mean of the budget share. The compensated price elasticity measures the portion of change in quantity demand as a result of changes in prices, and it does not capture the real income effect as the uncompensated price elasticity does. Given that food consumption in low-income food-deficit countries is very much dependent on household income (Maxwell &

Frankenberger, 1992), SISMod focuses on the uncompensated price elasticity, which captures both price effects and income effects.

Semi-quantitative food frequency questionnaires are used in CFSVAs to collect food consumption information over a seven-day period. As pointed out by Kristal (1994), these questionnaires are often used to calculate nutrient intakes by multiplying the standard portion size with the nutrient density. We follow the same approach to derive food intake in grams. Since the standard portion sizes are not available in the CFSVA data, we use the food consumption score (FCS) (WFP, 2008) in the dataset as a proxy to estimate them. FCS is highly correlated with per capita calorie consumption (Wiesmann D, 2009), and its cut-off point (which defines adequate food consumption) corresponds to the food intake benchmark of 2,100 kcal per capita per day. We assume the average number of days of consumption of each food group[6] at the cut-off point is equivalent to the caloric contribution of each food group in a 2,100 kcal daily diet based on FAO's food balance sheet. The average food intake (in grams) of each food group is derived from the caloric contribution and caloric densities from NutVal-3.0[7] and is considered as the standard portion size.

2.5 Measuring Food Security: SISMod Indicators

Post-shock household food consumption is derived after the two-stage demand system. By using caloric densities as the energy conversion factors, food consumption is converted from quantity to food energy and is expressed in terms of dietary energy consumption in kcal per capita per day. The dietary energy threshold (DET) is used to identify food-deficient households. Those with a per capita food energy consumption below the DET are classed as food deficient. The standard DET is the daily requirement of 2,100 kcal per person per day. Additional thresholds are set in the model to distinguish different food consumption levels and classify households into different consumption groups.

Proportion of food energy deficient population and depth of hunger

SISMod estimates three indicators to describe the energy intake status of a population or subgroup: the proportion of the population who are food-energy deficient; the depth of hunger; and the food shortfall. The first indicator refers to the percentage of people with dietary energy consumption below the DET. The depth of hunger indicates how many calories would be needed to meet the DET. It is calculated as the product of the average dietary energy consumption of the food-deficient population and the number of food-deficient people; this is then normalized by the total population.

Population of food energy deficient and food shortfall

The size of the population who are deficient in food energy can be estimated by projecting the proportion of food deficiency upon total population figures, while taking into account population

[6] Derived from the 'seven-day consumption recall' section of the questionnaires submitted in the more frequent assessments (e.g. CFSVA or CFSNS).

[7] NutVal is an application in Excel used to calculate the nutritional content of a food basket. See http://www.nutval.net/

growth. The food shortfall is the result of converting the depth of hunger (in kcal) for all food-deficient people in a month to the equivalent weight of cereals (in metric tonnes).

For this specific model, these four indicators capture different aspects of hunger. The number of food energy deficient people is a headcount. The depth of hunger and the food shortfall capture the degree of inequality among the food deficient. Only a joint consideration of these indicators can provide an adequate description of food insecurity.

2.6 Limitations

Like any economic model, SISMod-Light has its limitations and caveats. When interpreting its results, a number of points should be considered.

(1) The baseline data was collected in the lean season of 2012, in the case of Liberia and Guinea, and in the lean season of 2010 in the case of Sierra Leone. Patterns of household behaviour may have changed since then.

(2) Analysis of sub-population groups is limited by the sample design. Although the survey is representative at the first level of administrative area, it may not be representative at lower levels if the sample size within the sub-population group is too low.

(3) The degree of detail in the model is restricted by the household survey data. For example, household consumption was calculated using semi-quantitative frequency questionnaires. Also, for Liberia, total expenditure was assumed to be unit elastic since the income data were only available in terms of percentage share by income source, but not in actual terms.

(4) For factors that do not affect household income and expenditure directly, such as trade performance, policy or level of food stock, SISMod-Light has to model their impact through food prices, which are directly linked to household spending decisions.

(5) Aid and assistance received by households at the time of the household surveys was not significant. In Sierra Leone, it accounted for just 3 percent of total household income. It is therefore difficult to model the impact of social economic support during the crisis, given that the base was insignificant.

(6) The lack of robust and timely data on economic conditions, in particularly data at sub-national levels, means that the simulations rely a lot on assumptions.

(7) The rapidly changing conditions also make the outlook of food security difficult to forecast.

Despite these limitations, SISMod-Light can provide useful insights into the implications of Ebola's economic impacts on household food security. It is especially useful for short-to-medium term forecasts. One useful feature of this approach is that it allows the flexibility of updating the model, so that the most up-to-date scenario can be simulated as soon as new data become available.

3 Ebola Scenarios and Impacts on Household Food Security

Liberia is now Ebola-free, and the number of cases has plummeted to single digits in Sierra Leone and Guinea. The epidemic appears to have turned a corner. However, it has already posed significant threats to household food security through economic downturns that are likely to continue before the economies of these countries fully recover. Considering the short and medium-term impact of the epidemic, SISMod-Light simulates scenarios covering different periods of time for each of the three countries to describe the most likely situations arising from the shocks to household food security.

The scenarios capture the economic impacts of Ebola on households, mainly through changes in incomes and food prices. They build on reports such as FAO/WFP's Crop and Food Security Assessment (CFSAM) (FAO and WFP, 2014) and the World Bank's *The Economic Impact of the Ebola on Liberia, Sierra Leone and Guinea* (World Bank, 2015). Considering the lack of timely and robust data, this study also used additional currently available secondary data, which provide more disaggregated information.[8]

- The first scenario is the most likely scenario for H1-2015, which represents stable food prices and an economic downturn. It is based on the assumption that income and crop production losses in 2015 would follow the trend of GDP losses.
- The second scenario combines the first scenario with a potential increase in food prices in the lean season, which will start in Q3-2015.

SISMod-Light has been applied using before-and-after comparisons to measure the impact of shocks on household food security. The simulation results of the two scenarios are compared to reference scenarios that reflect the situation in 2013 before Ebola and the peak of the epidemic in Q4-2014.

Based on the very limited existing economic and market data at the time of the writing, the following assumptions are made to define the major shock factors in SISMod-Light. Table 1 summarizes the major shocks based on the assumptions for the scenarios; the magnitude of shocks may vary across districts within the same country.

- **The 2014/2015 harvest** is slightly below average. However, the modest national decline masks the significant production shortfalls in hard-hit areas (FAO and WFP, 2014).
- **Income from agricultural sales and labour** mirrors the 2014 crop production drop. It will likely decrease further in 2015 as a result of limited access to agricultural inputs caused by lower household incomes and disrupted markets.
- **Income from wage, petty trade, hunting, mining and other typical sources** fell because of measures to control Ebola and people's fears of the disease, which restricted the movement of goods and people (FEWS NET, 2014). Despite the lifting of Ebola quarantines, the economic slowdown foreseen for 2015 will reduce household incomes in H1-2015 (FEWS NET, 2015). Incomes will then linger at the bottom in Q3-2015.
- A relatively stable, or slowly decreasing **trend in food prices** was seen during the 2014 harvest; some prices were even below 2013 levels. When converting prices in real terms by the non-food CPI deflator, the decrease is more obvious. Food prices in H1-2015 are expected to be similar to

[8] UN organizations provided information on different aspects of the Ebola crisis. WFP VAM and mVAM, FAO, WHO, World Bank, FEWS-NET, Mercy Crops and the governments of the three countries provided more spot insights into the trends.

2014 levels. However, during the lean season in Q3-2015, upward price trends are anticipated due to the low food supplies.

Table 1: Key shock factors based on the scenario assumptions (% changes from previous period)

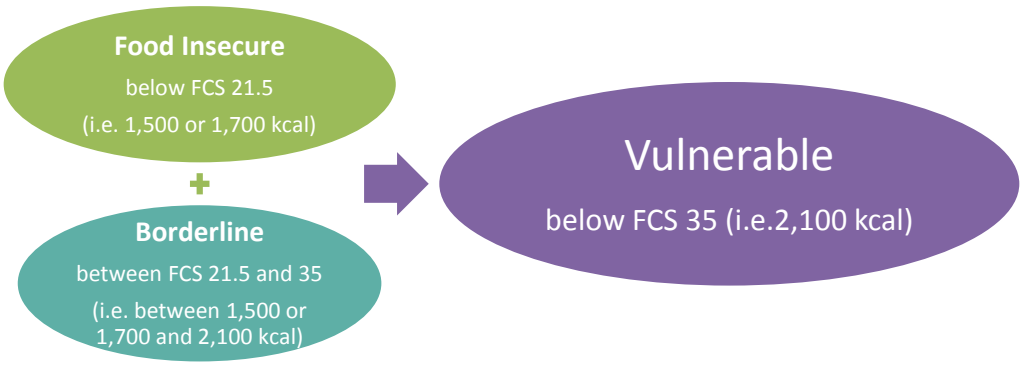
	Sierra Leone			Liberia			Guinea		
	2014	2015 Q1-Q2	2015 Q3	2014	2015 Q1-Q2	2015 Q3	2014	2015 Q1-Q2	2015 Q3
Agricultural production sale	-17% to -3%	-11% to -3%	0%	-20% to -7%	-3% to 0%	0%	-14% to -3%	-4% to -7%	0%
Agricultural wage	-17% to -3%	-11% to -3%	0%	-20% to -7%	-13% to 0%	0%	-15% to -4%	-6% to +1%	0%
Non-agricultural wage	-14% to -10%	-11% to -3%	0%	-38% to -5%	-13% to -10%	0%	-6% to 0%	-2% to -9%	0%
Other Income	-14% to -10%	-11% to -3%	0%	-30% to -5%	-14% to -1%	0%	-13% to +3%	-11% to 0%	0%
Remittance	+1%	0%	0%	NA	NA	NA	0%	+3%	0%
Staple food prices	-5% to 0%	0%	+4% to +17%	+5% to +47%	0%	+3% to +11%	-29% to +70%	0%	+5% to +19%

The magnitude of the food gap is a critical dimension to gauge the severity of food insecurity. To better inform the humanitarian response, we defined different thresholds of food intake for SISMod-Light.

As mentioned in the methodology, since the CFSVA consumption data used to build the model is semi-quantitative (i.e. consumption frequency), we have assumed that the consumption threshold of FCS 35[9] is equivalent to a caloric intake of 2,100 kilocalories per person per day. Households that do not meet this threshold are defined as *Vulnerable*.

In addition, a lower threshold is set at the cut-off point of FCS 21.5.[1] Because of the different consumption patterns and distributions among the three countries, this is equivalent to 1,700kcal for Sierra Leone, and 1,500kcal for Liberia and Guinea. The vulnerable are further categorized as *Borderline* (between the low threshold and FCS 35) and *Food Insecure* (below the lower threshold). The food-insecure group is the main focus of this paper.

Figure 2: Levels of food insecurity and thresholds used in the application



[9] Consumption thresholds are set as FCS 38 and FCS 24 for Liberia as suggested in the WFP CFSVA report 2012.

4 Overview: Economic Impacts of Ebola on Household Food Security

Subject to the aforementioned assumptions, the simulation suggests that the number of food-insecure people could reach 6.2 million during the lean season in Q3-2015. This represents 27 percent of the combined population of the three Ebola-stricken countries. In other words, approximately one in four households would be food insecure.

According to SISMod-Light, the three countries already suffered from chronic food insecurity before Ebola, when the number of food insecure was estimated to be 1.6 million. Considering the existing fragility of the economies, Ebola's economic side effects could be far-reaching. In H1-2015, with the assumed fall in household income, the number of food insecure would reach 3.7 million. A significant surge in the number of food insecure is expected during the lean season in Q3-2015; household access to food would be squeezed by seasonal high food prices and low incomes. The number of food insecure would then increase to 6.2 million.

Figure 3: Number of food-insecure people in Sierra Leone, Liberia and Guinea, 2013 – 2015

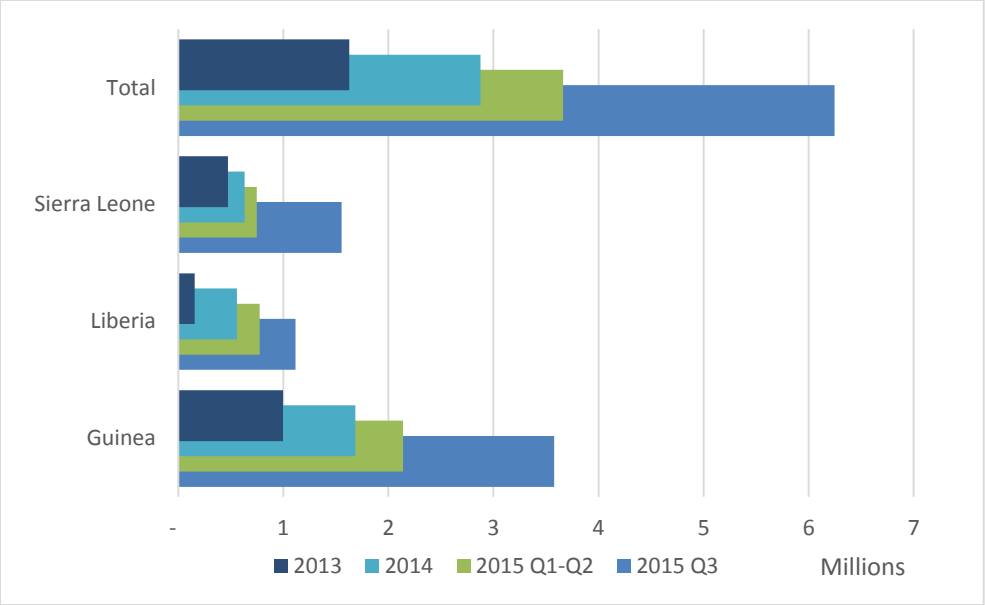
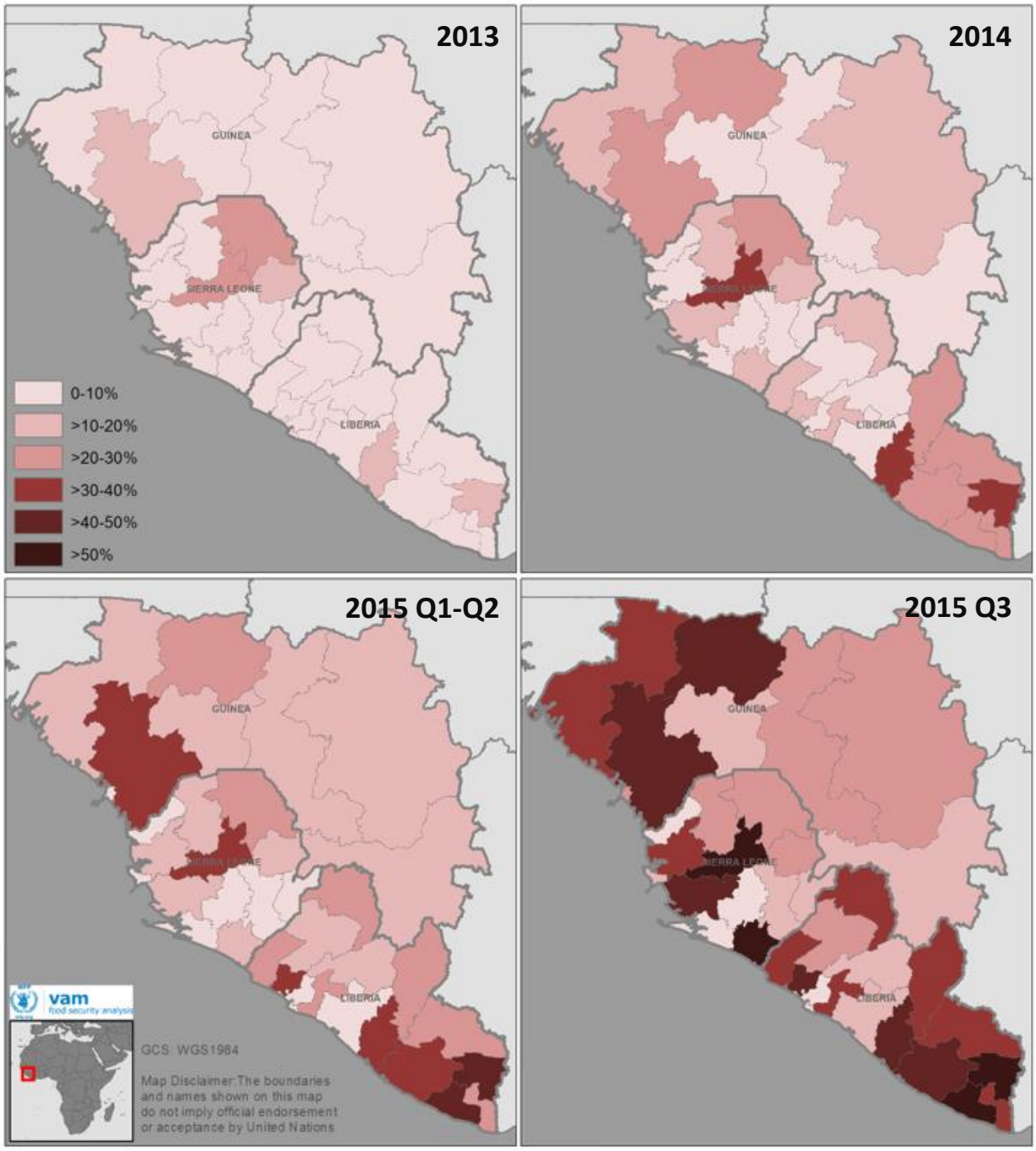


Figure 4: Map of the proportion of food-insecure people in Sierra Leone, Liberia and Guinea, 2013 – 2015

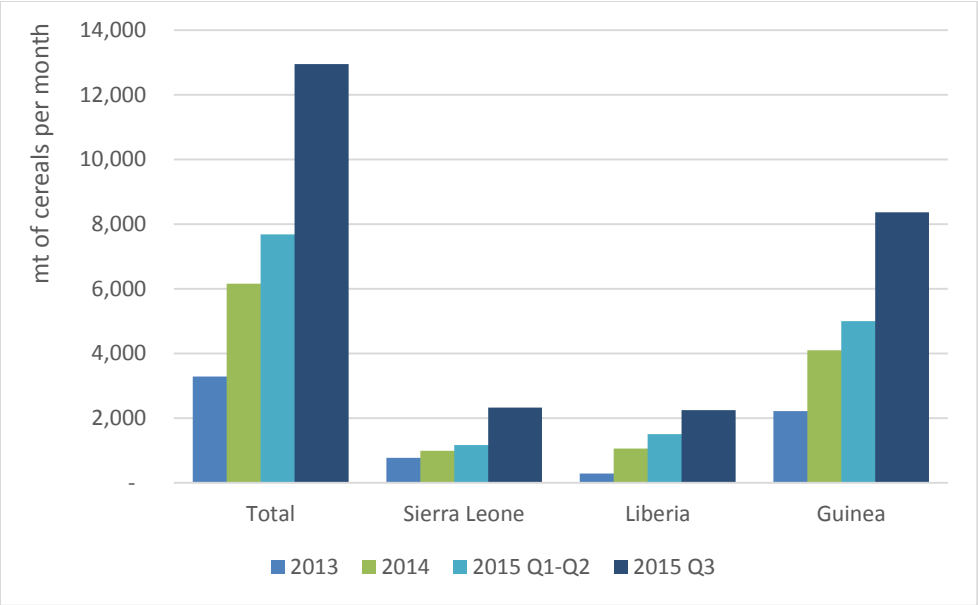


Zooming in on each country, the most food-insecure areas may not be the areas where Ebola was most prevalent. This is because of different livelihoods and levels of poverty. Further discussion on subnational food security can be found in section 5. From the simulation results, high food insecurity is expected in Port Loko, Tonokilili, Mayamba and Pujehum in Sierra Leone; Bomi, Grand Kru, Montserrado, River Cess, Sinoe and River Gee in Liberia; and Kindia and Labé in Guinea. Figure 4 shows the most likely areas of food insecurity in H1-2015 and the lean season of Q3-2015. The simulation results also suggest

that households who live in rural areas with a high dependence on agriculture but very low incomes would be the most vulnerable.

The minimum food intake threshold is set at the equivalent of FCS 21.5[10] as described in the approach section. The total food shortfall for the three countries in H1-2015 is estimated at 7,687 mt of cereals a month. During the lean season, the food shortfall would potentially increase to 12,949 mt of cereals a month, two-thirds of which would be needed in Guinea.

Figure 5: Food shortfall in Sierra Leone, Liberia and Guinea, 2013 – 2015



[10] The lower threshold of FCS is equivalent to 1,700 kcal per person per day for Sierra Leone, and 1,500 kcal for Liberia and Guinea.

5 Food Security Analysis by Country

This section presents disaggregated results to learn about how Ebola affects the food security of each of the three countries and their sub-population groups.

5.1 Sierra Leone

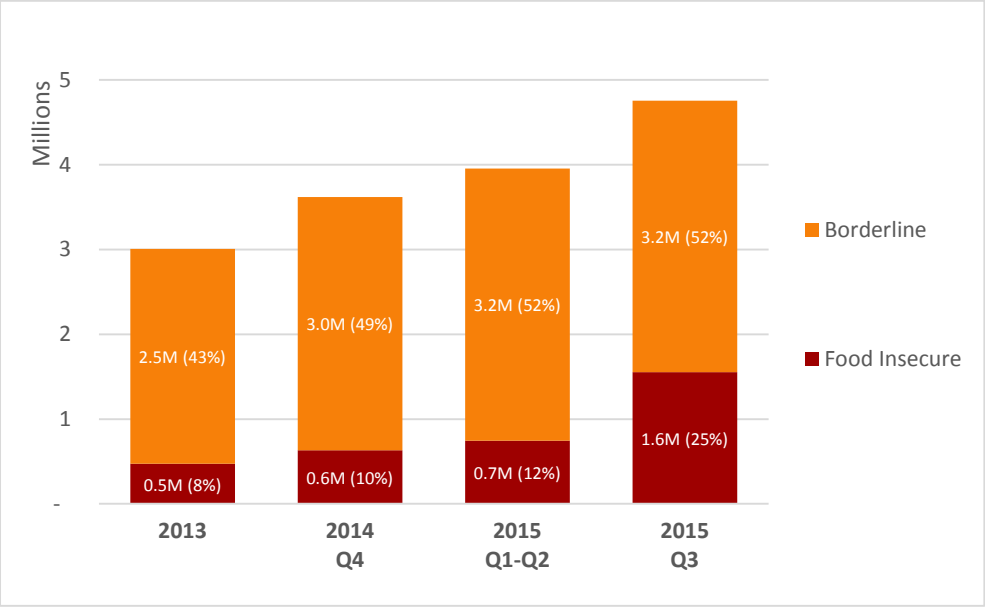
Current epidemic

In the week to 17 May, eight new cases of Ebola in Sierra Leone ended a sequence of three consecutive falls in weekly case incidence (WHO, 2015). The number of cases keeps fluctuating, although it has significantly declined. Sierra Leone is the worst-hit country with more than 12,500 Ebola cases. Disease transmission in the western and northern districts has been the most intense, and most cases are in Bombali, Kailahun, Kenema and Port Loko, as well as Western Area Urban and Western Area Rural

Food insecurity

The simulation results suggest that before Ebola, almost 3 million people – half of the population – were vulnerable to food insecurity. Of them, 474,000 people were food insecure. The economic impact of Ebola pulled an additional 159,000 people into food insecurity in Q4-2014. The simulation found that the number of food insecure will continue to increase in H1-2015 but at a slower rate, under the assumption of relatively stable food prices. That would leave 747,000 people food insecure by the end of Q2-2015. The number of food insecure would reach a peak of 1.6 million in the lean season of Q3-2015 because of low incomes and seasonal food price increases. This would leave half the population in a situation of borderline food insecurity.

Figure 6: Number of borderline and food-insecure people in Sierra Leone, 2013 – 2015



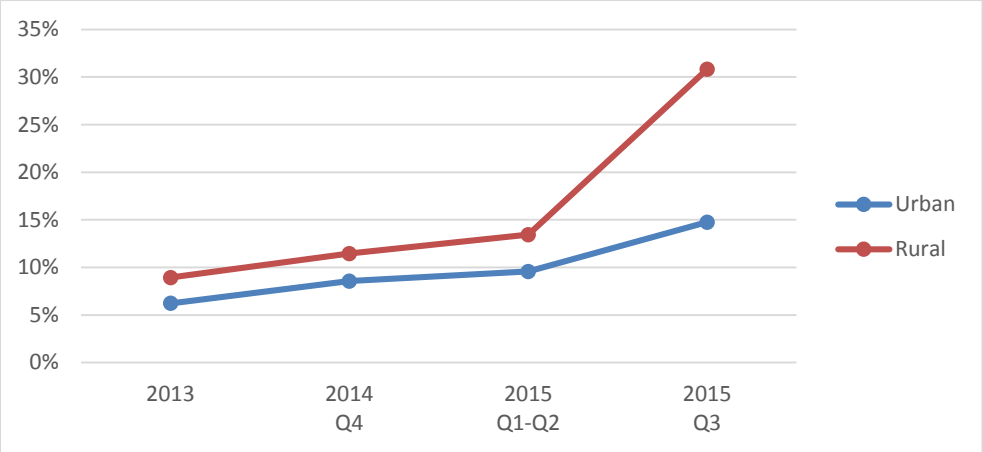
Vulnerable groups

The impact of the economic slowdown varies among different population groups. The simulation results have been disaggregated into different sub-groups according to living areas (urban/rural), districts, income class, livelihood and gender of household head.

Urban/rural areas

The disaggregated results show that, in Q4-2014 and H1-2015, when household income is assumed to decrease but food prices remain stable, the number of food insecure in urban and rural areas is estimated to grow at similar rates, with a 2 percentage point increase from each reference period. However, when the shock of rising food prices hits during the lean season, people in rural areas are expected to be more vulnerable. The number of food insecure would increase by 17.4 percentage points to 31.8 percent in rural areas, which is three times faster than in urban areas. This suggests that rural households are more vulnerable to price shocks in the lean season when market dependence peaks and household incomes are low.

Figure 7: Proportion of food-insecure people in Sierra Leone (by urban/rural area), 2013 – 2015



District

Western Area, where the capital Freetown is located, was the Ebola 'hotspot'. It has had the highest number and prevalence of reported cases – around 40 percent of all cases in Sierra Leone (Ministry of Health and Sanitation, Government of Sierra Leone, 2015). As Freetown is the major port for importing rice into the country (WFP, 2013), the food supply in the district has been relatively stable. Households here largely depend on markets for food (FEWS NET, 2010). However, the district has the highest proportion of households in the richest quintile (WFP, 2011), and therefore the proportion of food insecure would increase gradually to 10 percent in H1-2015 and 15 percent in Q3-2015.

After Western Area, Tonkolili has had the highest Ebola infection rate. Although the district has one of the world's largest iron ore deposits, households here have the lowest incomes and Tonkolili has the highest proportion of severely food-insecure people in the country (WFP, 2011). Households here mainly rely on rice and cassava production, participating in small-scale mining to supplement their incomes. The model suggest that Tonkolili will have the highest proportion of food-insecure population throughout the subject periods, reaching 40 percent in H1-2015 and 67 percent in Q3-2015, when already low incomes and purchasing power are reduced still further.

In Q3-2015, food insecurity is expected to grow at different rates mainly because of the different magnitudes of seasonal food price increases. Based on historical price trends, a jump in food prices of

between +4 percent and +17 percent is assumed. The biggest jump would be in Kono, Bombali, Port Loko, Tonkolili, Moyamba and Pujehun. Food security in these districts would deteriorate quickly in Q3-2015, most quickly in Tonkolili, Moyamba and Pujehun. The number of food-insecure people would peak at 67 percent in Tonkolili, 60 percent in Pujehun and 47 percent in Moyamba. This is no surprise since these three districts were considered to be the most vulnerable in terms of food insecurity in the baseline CFSVA survey (WFP, 2011).

Figure 8: Proportion of food-insecure people in Sierra Leone (by district), 2013 – 2015

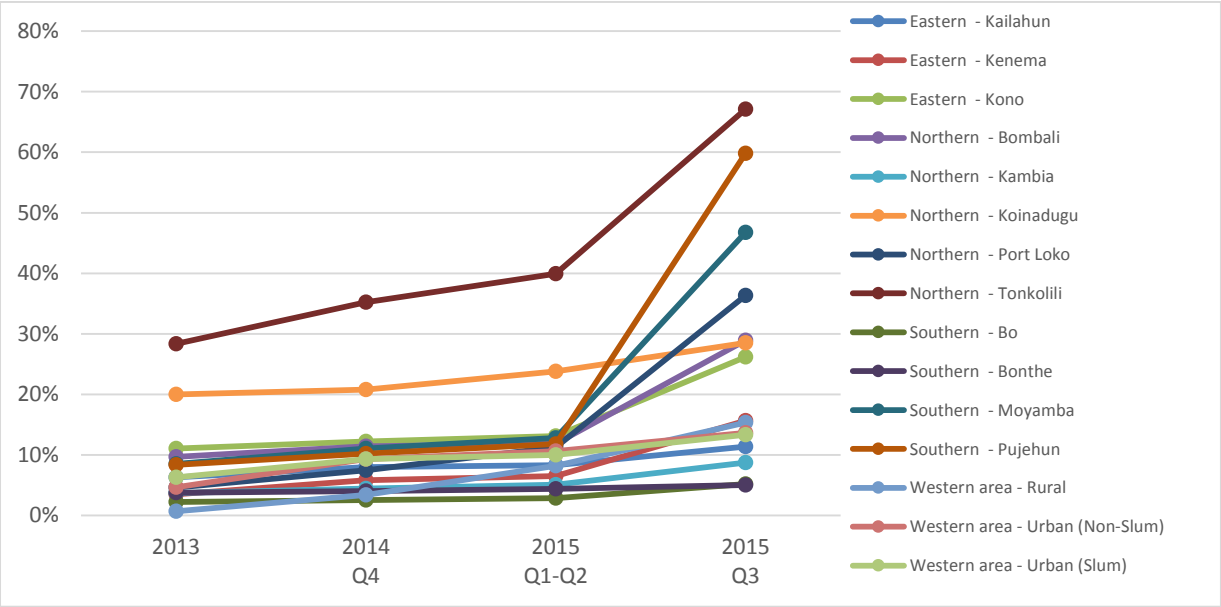
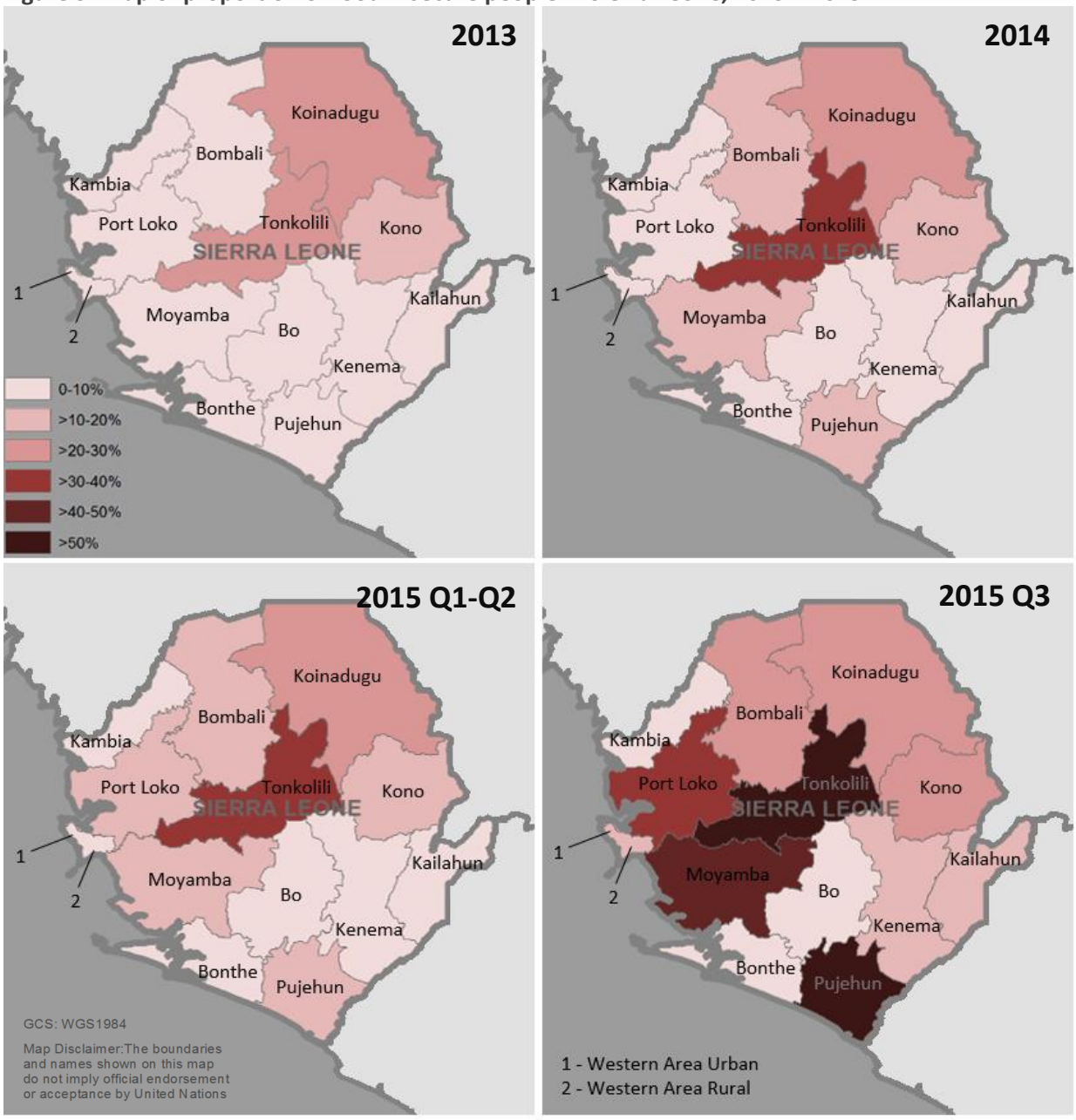


Figure 9: Map of proportion of food-insecure people in Sierra Leone, 2013 – 2015

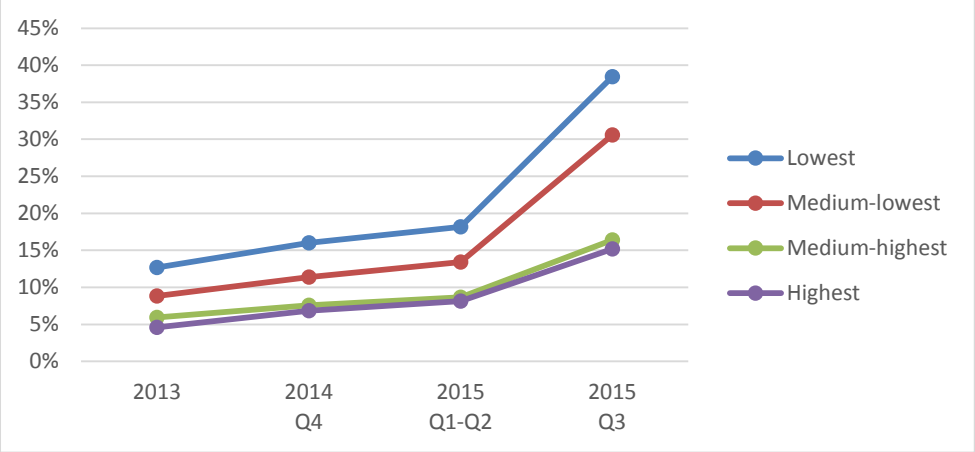


**Western Area urban slum and non-slum areas are aggregated because of missing polygons*

Income level and livelihood

Food insecurity, as expected, would be more severe among households in the lower income quartiles. A price shock is expected to have clear effects on the levels of vulnerability between the two lowest and the two highest quartiles of per capita income. Before the assumed seasonal price increase in Q3-2015, gradual upward trends are expected in all income quartiles. The proportion of food-insecure people would increase at a faster pace in the lowest quartile – by 20 percentage points to 39 percent, and by 17 percentage points to 31 percent in the medium-lowest quartile. In the two highest quartiles, the increase is expected to be similar at 7 percentage points, corresponding to 16 percent of the total population.

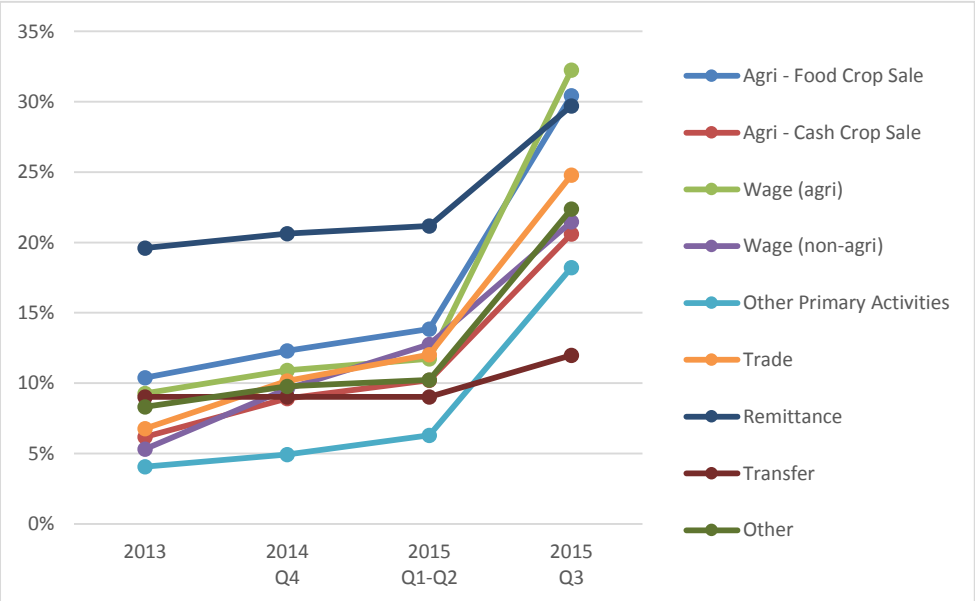
Figure 10: Proportion of food-insecure people in Sierra Leone (by income quartile), 2013 – 2015



Examining the situation by livelihood (or main source of income), food insecurity is thought to have gradually increased among all groups between 2013 to H1-2015. With the assumption of fewer employment opportunities and lower trading volumes, households who rely most on non-agricultural and trade activities are expected to fall into food insecurity at a slightly faster pace (3 percentage points on average) compared to the average increase expected for other groups (1 percentage point).

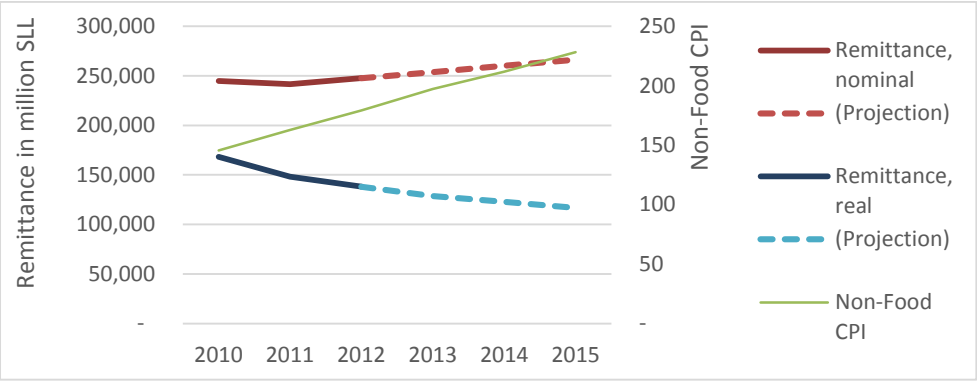
The rates of food insecurity of the largest livelihood group, *Agri - food crop sale*, are expected to be a little above other groups, increasing steadily from 10 percent in 2013 to 14 percent in H1-2015. However, in Q3-2015, a rapid growth of 17 percentage points is expected for this livelihood group, and the food insecure would peak at 30 percent. A similar trend is found for the *Wage (agri)* group. This reflects the fact that households who rely on food crop sales and agricultural wages are sensitive to price shocks: they have the lowest incomes – less than half the income of the highest group – and they rely more on market supply in the lean season.

Figure 11: Proportion of food-insecure people in Sierra Leone (by main source of income), 2013 – 2015



It is worth noting that although remittance trends have been stable in nominal terms, they have been decreasing in real terms because of high inflation. If the nominal value of remittances is deflated by non-food CPI, its value in 2015 is expected to shrink by a third (compared to 2010 levels). The sample size of the remittance group is too small to provide robust statistical information, and informal inflows are unknown. Therefore, these results should be verified and carefully interpreted. Nevertheless, they do provide some indication that households who depend heavily on remittances and lack income diversity would also be at risk of food insecurity.

Figure 12: Trend of remittance inflow and non-food CPI in Sierra Leone, 2010 – 2015

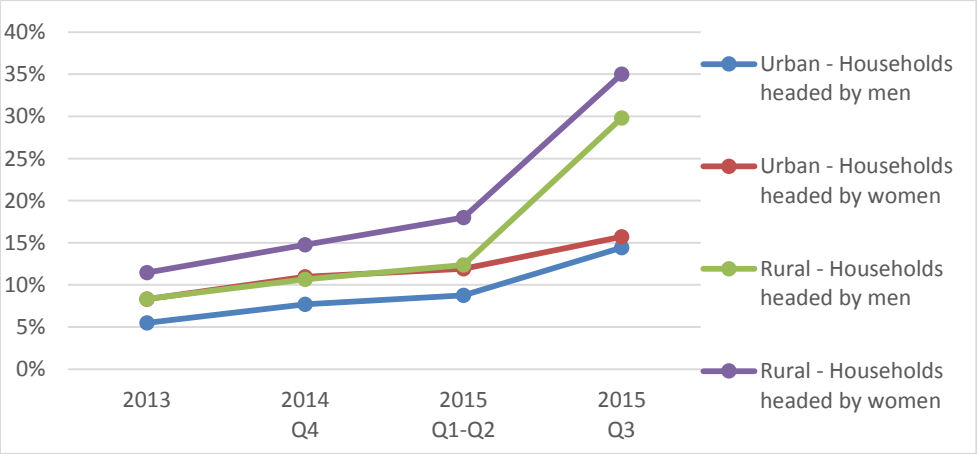


Source: Bank of Sierra Leone and authors' calculation

Gender

According to the baseline survey data, one fifth of the interviewed households were headed by women. The simulation has identified rural households headed by women as the group at higher risk of food insecurity. Before Ebola, in 2013, 11 percent of this group were food insecure; in H1-2015, this proportion is expected to reach 18 percent. During the 2015 lean season, food insecurity would almost double to reach 35 percent. A similar trend is expected for rural households headed by men, but the rate of food insecurity would always be 3 to 5 percentage points lower than for households led by women. In urban areas, trends would be slightly higher among households headed by women than those headed by men.

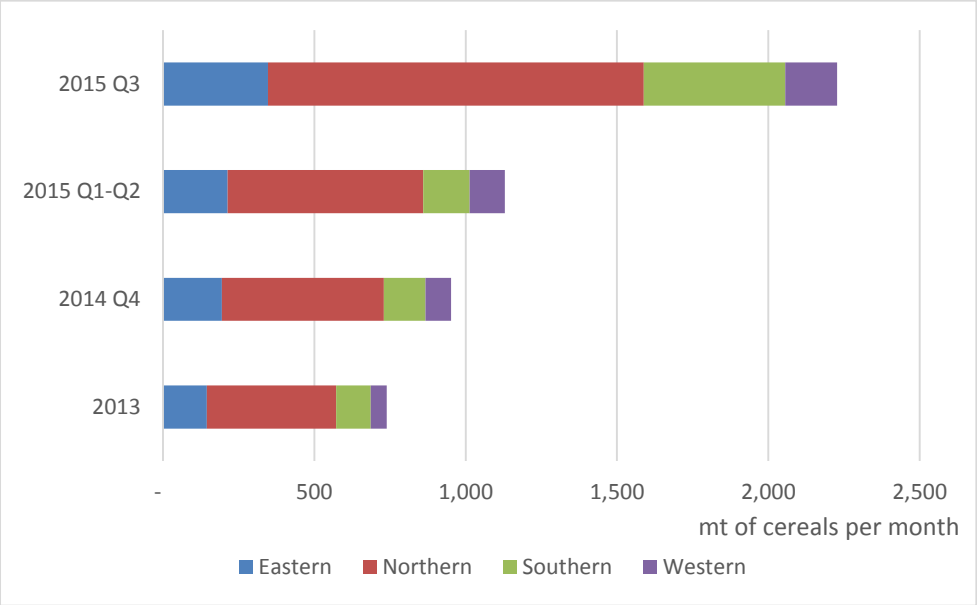
Figure 13: Proportion of food-insecure people in Sierra Leone (by urban/rural and gender of household head), 2013 – 2015



Food shortfall

The simulation results indicated that the food insecure would have to face a total food shortfall that would increase from 739 mt a month in 2013 to 952 mt a month in H1-2015. The seasonal price shock would double this shortfall to 2,227 mt a month. Northern Province is expected to be the most severely food insecure and because of its large population, this region would need more than the sum of all other regions, bearing around 55 percent of the national shortfall at all times. If food assistance is extended to all vulnerable people, not only the food insecure, the total shortfall to cover would be six to eight times more, peaking at 13,817 mt a month in Q3-2015.

Figure 14: Food shortfall in Sierra Leone (by region), 2013 – 2015



5.2 Liberia

Current epidemic

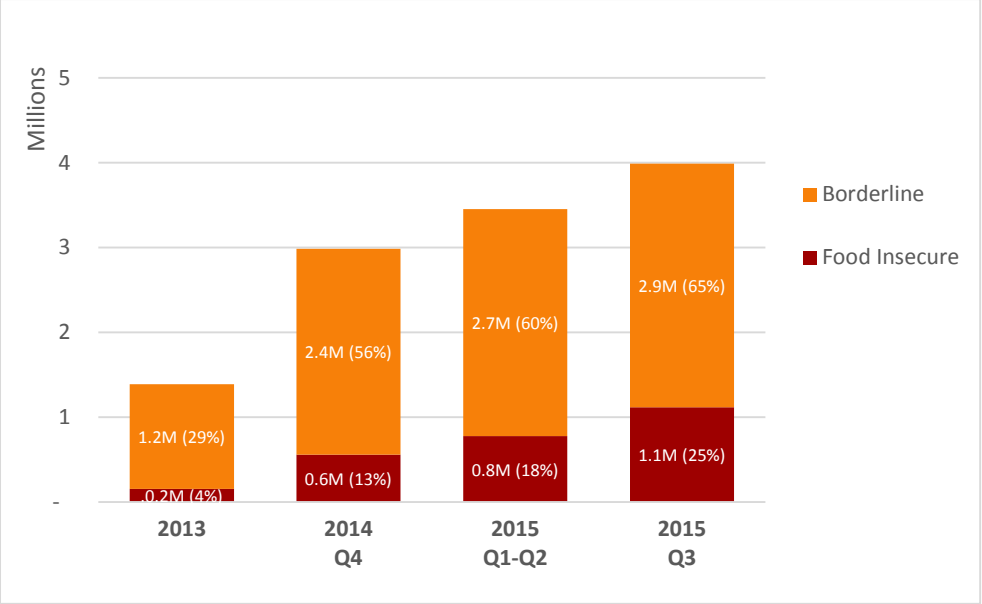
The Ebola outbreak in Liberia was declared over on 9 May 2015. The death toll has reached 4,769, with over 10,600 people infected since the first case of the virus was reported in the country in March last year. Though Liberia had fewer cases than Sierra Leone, it recorded the highest number of deaths. The highest incidence was registered in Margibi, followed by Montserrado (both rural and urban, Bomi), Lofa, Grand Cape Mount and Bong.

Food insecurity

Before Ebola, in 2013, Liberia's population was 4.25 million, a third of whom were vulnerable to food insecurity according to the simulation results. Of those, 156,000 people are estimated to have been food insecure. Ebola first emerged in Liberia in March 2014 and spread to districts with devastating economic impacts (World Bank, 2015). A worsening economic situation is assumed in 2015. In H1-2015, if the dwindling economy continues to limit household incomes and purchasing power, the food-insecure population will reach 776,000. Food insecurity is expected to be most common in the lean season in Q3-

2015. A further erosion of purchasing power would push an additional 339,000 people into food insecurity. The number of food-insecure people is expected to reach a peak of 1.11 million.

Figure 15: Number of borderline and food-insecure people in Liberia, 2013 – 2015



Vulnerable groups

The economic downturn has affected the population of Liberia in different ways, depending in part on their living conditions and livelihoods. Disaggregating the sample of 13,700 households into different sub-groups allows us to investigate the impacts of the shock caused by Ebola.

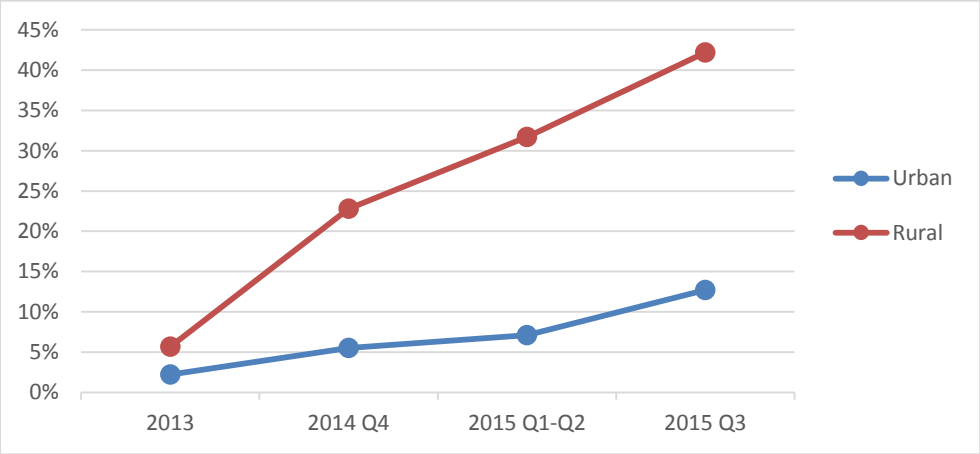
Urban/rural areas

The urban population in Liberia lives mostly in Monrovia, Montserrado, Nimba, Bong and Maryland, and they represent 56 percent of the total population. The urban environment had a higher incidence of Ebola, but most of the food-insecure people are expected to be in rural areas. The movement restrictions and border closures imposed to control Ebola made it difficult for rural populations to reach markets, and in particular peripheral markets, which reported reduced activities (FEWS NET, 2015). The drop in market activities affected the livelihoods and food access of the rural population. Nearly 60 percent of them rely on crop production and sale, and they purchase 74 percent of their food (WFP, 2010).

The number of food-insecure people in rural areas is thought to have quadrupled by the end of 2014, while the urban food-insecure population increased 2.5 times. With the assumption of an income shock in Liberia between Q4-2014 and Q1-2015, there is a minor and more distributed increase in food insecurity among the two different environments. The share of the population in need is expected to continue to increase in H1-2015 by 2 percentage points in urban areas, but by 9 percentage points in rural areas. The assumed seasonal price increases in Q3-2015 are expected to affect an additional 202,000 individuals (+10%) living in rural areas, leading to a peak of 816,000 food-insecure people. In urban areas, the number of food insecure is expected to reach 316,000 (+13%). The difference between

the groups suggests again that households in rural areas are more vulnerable to price shocks in the lean season, when they have less stock to sell and consume. In other words, they receive little income from their major income source – crop production – and they depend more on markets.

Figure 16: Proportion of food-insecure people in Liberia (by urban/rural area), 2013 – 2015



County

Figure 17 shows the different tendencies of the counties in Liberia, according to their economic and geographic characteristics.

In 2013, the positive impact of a good harvest and a growing economy with limited inflation prevailed (FAO and WFP, 2014). At that time, the highest number of food-insecure people lived in Nimba county – home to almost 30 percent of the nation's food insecure. The assumed income drop in this county would push 40,000 individuals (7%) into food insecurity in H1-2015 and another 64,000 (11%) in Q3-2015. The resulting food-insecure population is then estimated to reach 229,000 individuals – more than double that of the county with the second largest food-insecure population, Lofa (106,000 people).

In H1-2015, apart from Nimba, high increases in the number of food insecure (~10 percentage points) are expected in Bomi, Grand Cape Mount, Grand Kru, Sinoe and Montserrado. The price shock assumed in the lean season of Q3-2015 would bring new food insecurity, with major increases (>12 percentage points) in the food-insecure population in Montserrado, Bomi and Grand Cape Mount. This will result in around half the population being food insecure in River Gee, Grand Kru, Montserrado, Sinoe, Bomi and River Cess. The lowest levels of food insecurity will be in Bong, Grand Bassa and Monrovia (8%).

From the baseline data, River Cess and River Gee, both in the far-east on the border with Côte d'Ivoire, were already the poorest counties in Liberia, not only in income, but also in food security. The simulation results suggest that during the Ebola crisis they remained the counties with the highest proportion of food insecure. River Gee is thought to have seen a record 27 percentage point increase when Ebola hit in 2014. In H1-2014, the proportion of food insecure would rise to 46 percent in River Gee (40,000 people) and 39 percent in River Cess (36,000 people).

The model found that the food-insecure population rose the least in percentage terms in the capital, Monrovia: the proportion of food insecure is expected to be just 4 percent in H1-2015 and 8 percent in

Q3-2015. This is because in the simulation, Monrovia remains the richest county, even though households experience a significant drop in income. This is also backed up by mVAM findings in November 2014 (WFP, 2014).

Figure 17: Proportion of food-insecure people in Liberia (by county), 2013 – 2015

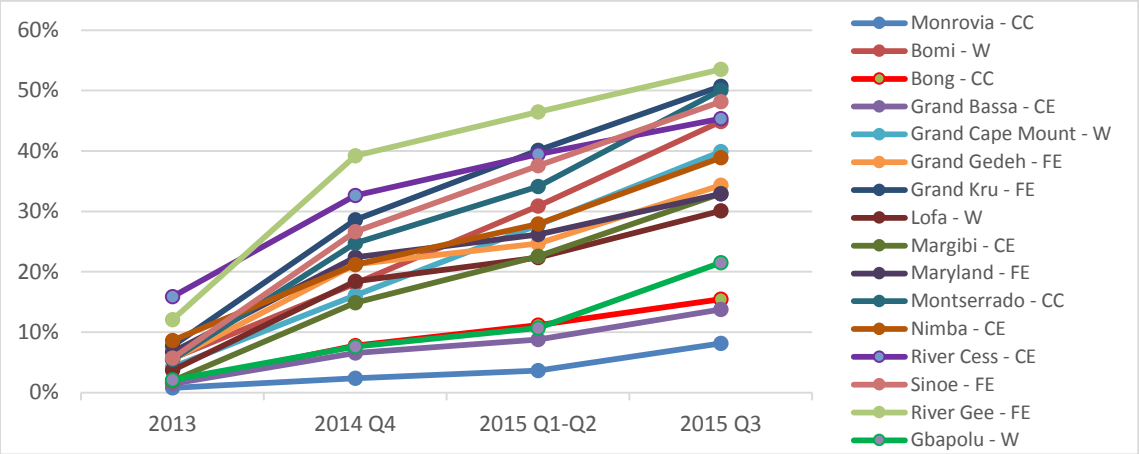
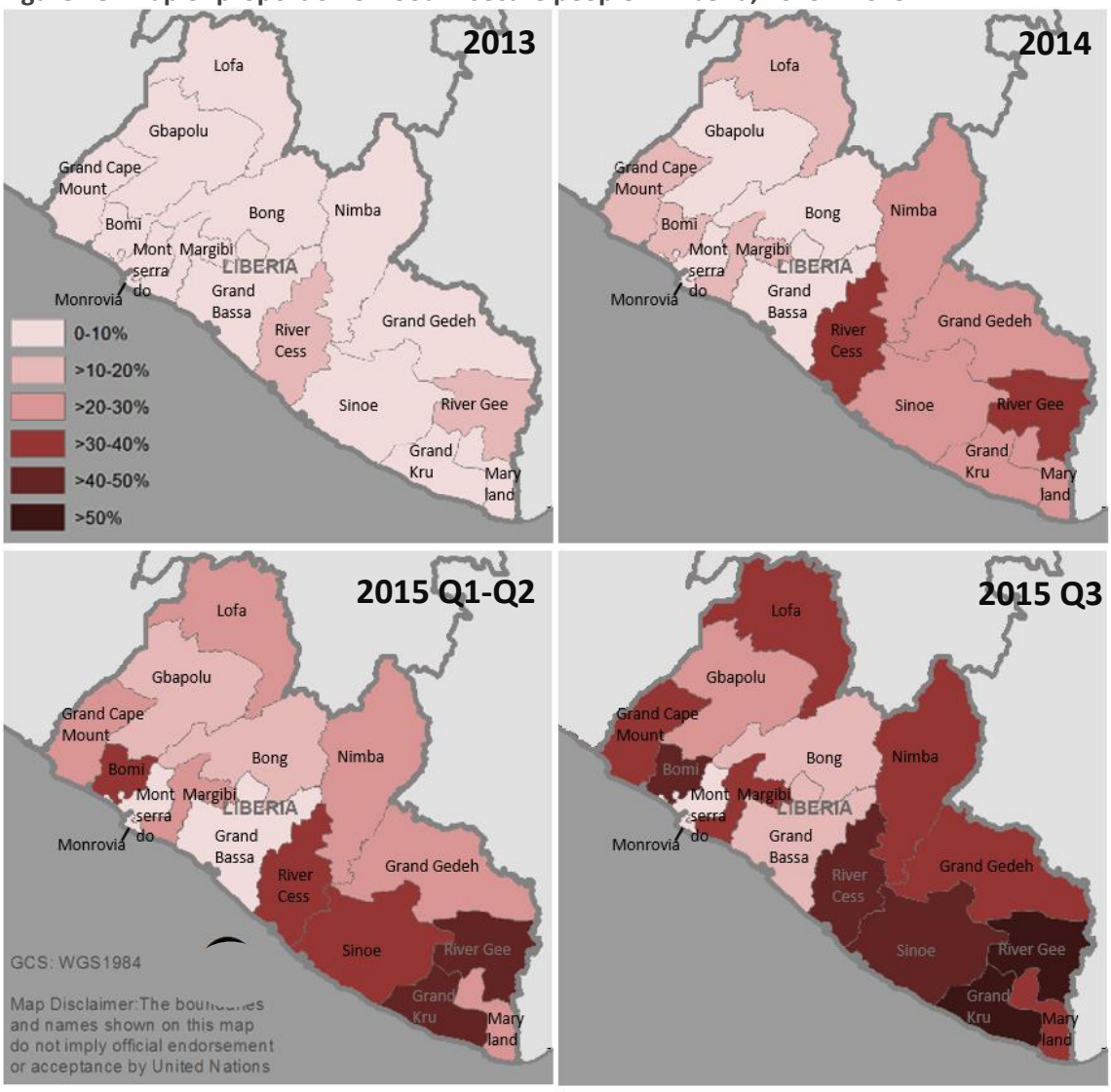


Figure 18: Map of proportion of food-insecure people in Liberia, 2013 – 2015



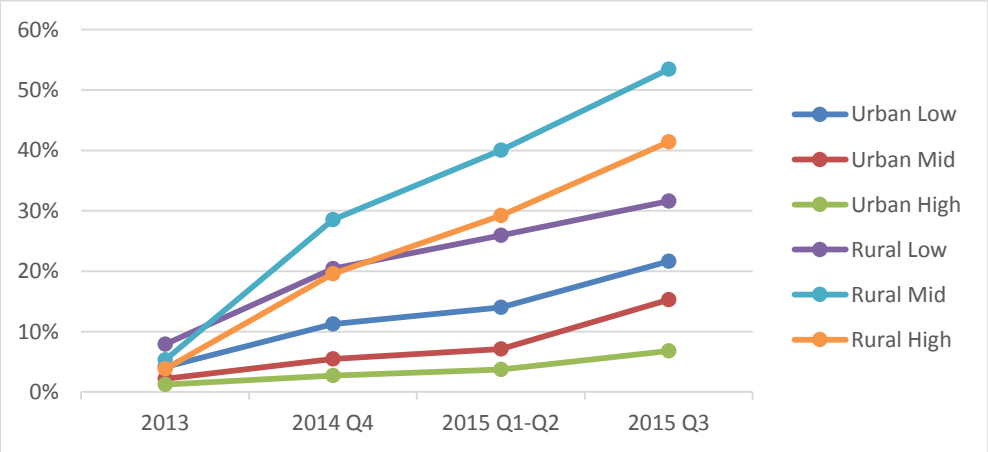
Expenditure level

In Liberia, the assessment data did not allow us to extract the value of income at household level, but per capita expenditures are commonly linked to per capita income. Total per capita expenditures were used to create the income level subgroups of this dataset, useful for the analysis.

By subdividing the expenditure level in three groups per area, we were able to gain a deeper understanding of the development of food insecurity resulting from Ebola. In fact, while the growth of the food-insecure population grouped by expenditure level follows expected trends in urban areas, there are counter-intuitive findings in rural areas: the population with the lowest expenditure is expected to be least exposed to shock. The poorest rural households rely more on their own food production: the baseline data shows that they produce 40 percent of their cereal consumption themselves. In the middle income group, this proportion is only 16 percent and for the high income group, it is 11 percent. With the lowest market dependency, the poorest rural households would, therefore, be relatively less affected. The food insecure within the group would grow at a slower rate: at 6 percentage points in H1-2015 (reaching 26% of the population) and Q3-2015 (32%).

In the simulations, the middle and high expenditure groups in rural areas are less resilient to both economic and price shocks, considering their higher market dependency and the hard hit taken by trade activities, waged contracts and primary activities (mainly mining) which these households rely on. In 2015, the capacity of these two groups to meet their food needs is expected to be limited and the proportion of food insecure would stand at 40 percent in H1-2015 and 53 percent in Q3-2015 for the middle income group, and at 29 percent in H1-2015 and 41 percent in Q3-2015 for the high income group.

Figure 19: Proportion of food-insecure people in Liberia (by urban/rural area and expenditure level), 2013 –2015



Livelihood

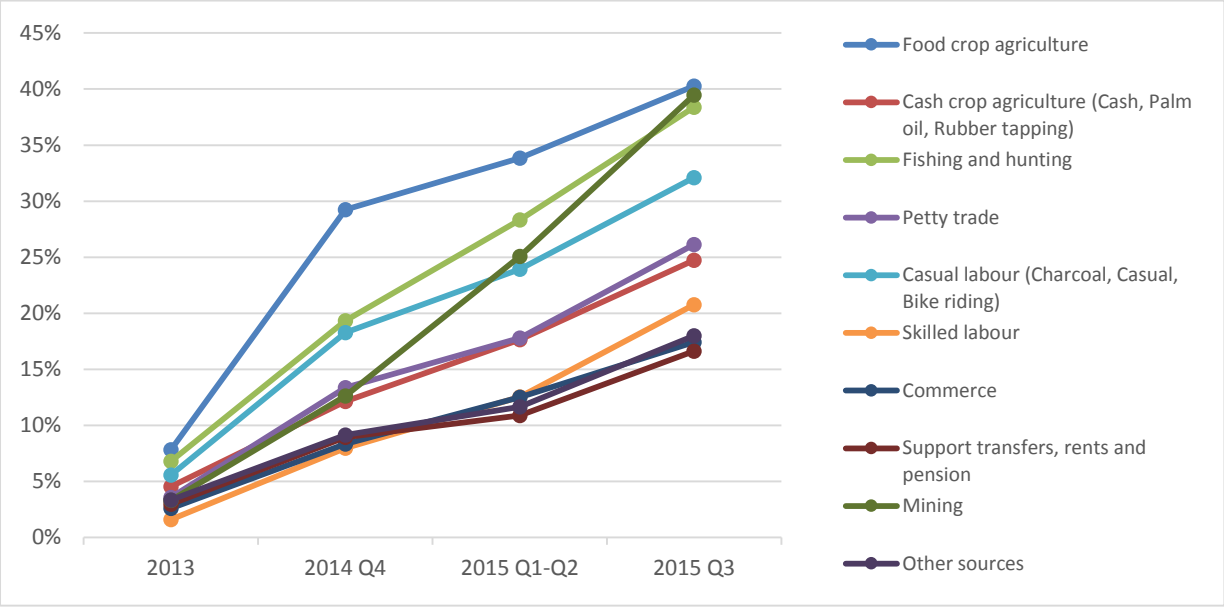
Food security analysis by main source of income reveals some interesting findings. Figure 20 shows how the largest share of food-insecure people is among those whose main source of income is food crop agriculture. In our projections, the food-insecure population grows to 105,000 people (29%, a 22 percentage point increase compared to 2013) at the end of 2014, and 147,000 people (40%) in Q3-2015.

Supply and demand have fallen because of the difficulty for fishermen to gather and sell their goods at the docks; the same has happened to people relying on hunting, since a ban on consuming bush meat created a huge drop in prices (and in demand). Both those livelihoods show a steady growth in food insecurity, only surpassed in relative terms by the insecurity faced by households whose main source of income is mining. A huge drop in income at the end of 2014 meant that those households fell into insecurity in H1-2015 and their insecurity is expected to grow with rising prices, considering their market dependency.

Casual and skilled labour face a similar growth in food insecurity, since many private-sector workers became unemployed with the economic contraction of 2014, thus leading their families towards food insecurity, in particular in the face of rising prices.

Cash crop agriculture and petty trade are paired in levels and speed of growth of insecurity, despite their inverse reaction to income and price shocks. Income shocks affect households who rely on the sale of cash crop products slightly more in H1-2015: their food insecurity rises 1 percentage point more than that of households relying on petty trade. Price shocks hit the latter group harder in Q3-2015, when their food insecurity rises 1 percentage point more than that of cash crop sellers.

Figure 20: Proportion of food-insecure people in Liberia (by main source of income), 2013 – 2015



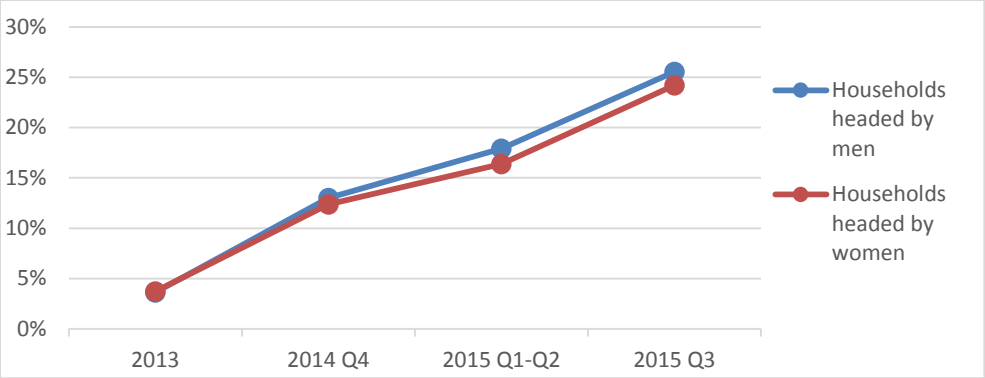
Gender

From the baseline data, 24 percent of Liberian households are headed by women. According to the model, Ebola-driven food insecurity will affect households headed by women and those headed by men in the same way. Their proportion of food insecure would grow in a linear pattern: 24 percent of households headed by women and 26 percent of those headed by men are expected to be food insecure in Q3-2015. Particularly in Monrovia, the proportion of food insecure in both types of household would be the same: 8 percent in Q3-2015.

Most households headed by women are in Monrovia, Bong, Lofa and Nimba – the richer and more urbanized counties. Because of this uneven distribution, national trends might mask disparity at sub-

national level. In fact if we take out Monrovia, home to 38 percent of all households headed by women, the proportion of food insecure in this group jumps to 36 percent – 4 percentage points higher than among households headed by men. These 4 percentage points of difference suggest a gender disparity during the Ebola crisis and that households headed by women who live outside Monrovia are more vulnerable.

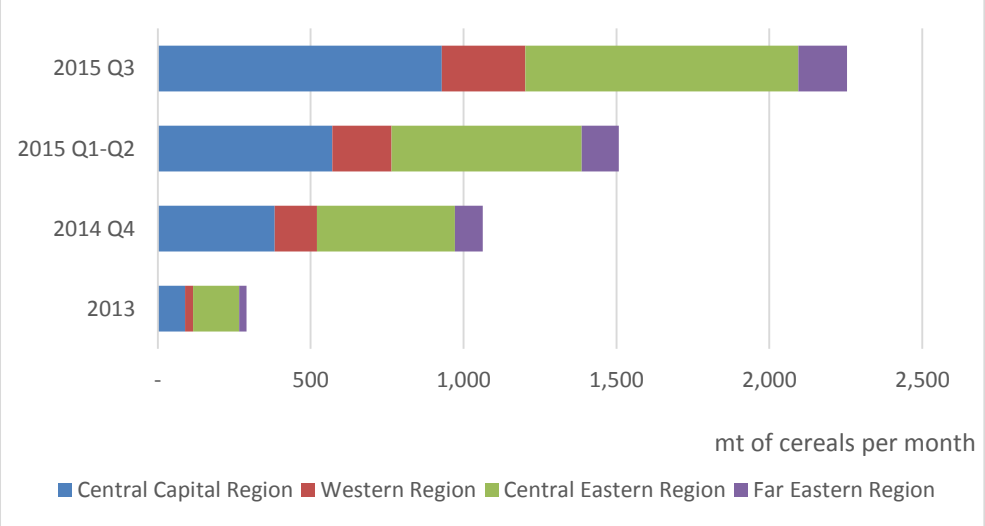
Figure 21: Proportion of food-insecure people in Liberia (by gender of household head), 2013 – 2015



Food shortfall

The simulation indicates that the food insecure population will face a total food shortfall that increases from 290 mt a month in 2013 to 1,508 mt a month in H1-2015. In this period, the area with the largest shock in relative terms would be the west, including the counties bordering Sierra Leone, with a monthly increase in food shortfall of 111 mt. When the seasonal price shock hits, the national shortfall is expected to increase by 746 mt, reaching 2,254 mt a month. The counties most in need in 2013 were Monrovia and Nimba, bearing 59 percent of the national shortfall. In 2015, the insecurity in Monrovia, with the assumed shocks, would lead even more people into deeper food insecurity, with a food shortfall of almost 110 kcal per day, together with an expanding population. In this scenario, the shortfall in Monrovia would be account for 41 percent of the national total shortfall.

Figure 22: Food shortfall in Liberia (mt of cereals per month), by region, 2013 – 2015



5.3 Guinea

Current epidemic

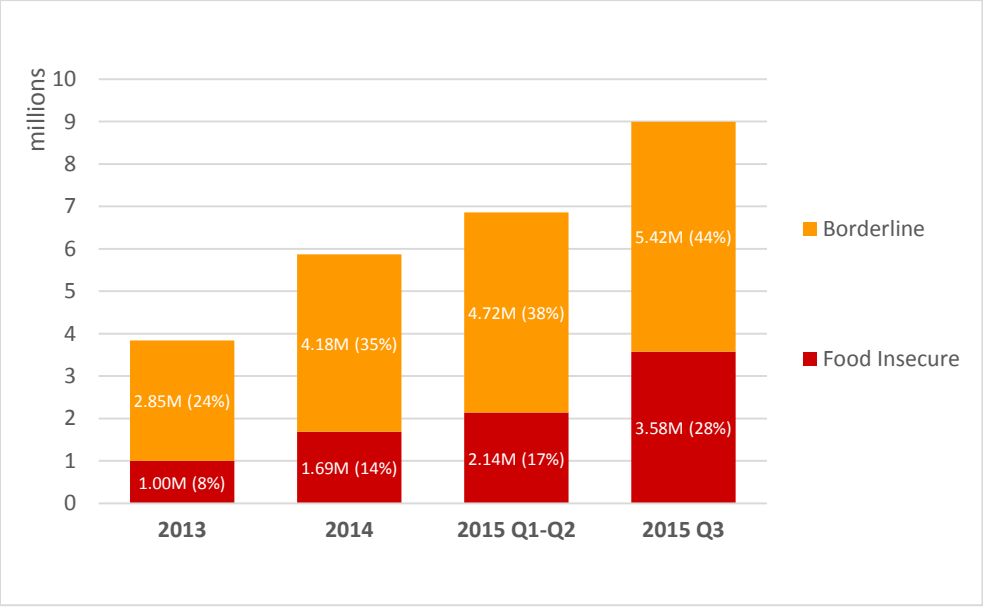
The death toll from Ebola has reached 2,407 in Guinea, with 3,635 people infected (WHO, 2015). Though there have been fewer cases in Guinea than in the other two countries and Ebola incidence has been lower, the spread of the epidemic started earlier here, in December 2013. The number of new cases has dropped from more than 200 in the worst week in October 2014, to 27 cases in the week to 17 May 2015. Despite the general slowdown, case incidence has fluctuated and there might be an increase in the weeks ahead. The new cases are mainly found in the western part of Guinea, in the districts of Forécariah, Dubreka and Boké. Since the beginning of Ebola, the highest incidence has been registered in Macenta, Conakry, Forécariah, Guackendou, Coyah and N'Zérékoré.

Food insecurity

Before Ebola, the Guinean population was estimated to be 11.75 million people, 1 million of whom were food insecure. Another 2.85 million were in a borderline situation, which means almost one third of the population were living in or vulnerable to food insecurity.

In the simulation, the impact of shocks in H1-2015 would create a food-insecure population of 2.14 million. The lean season of Q3-2015 could cause major insecurity, increasing the number of food insecure to 3.58 million people.

Figure 23: Number of borderline and food-insecure people in Guinea, 2013 – 2015



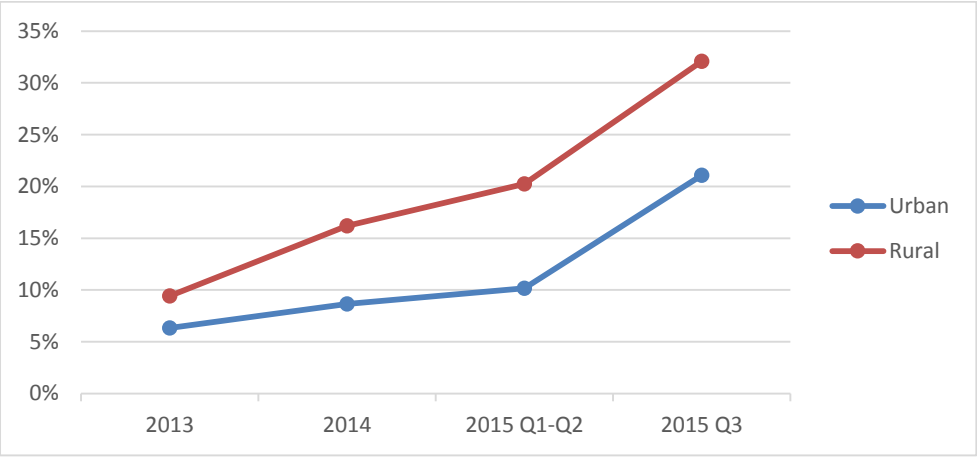
Vulnerable groups

The different effects of Ebola on the Guinean economy and food security are particularly visible in various environments and livelihoods. This disaggregation is possible thanks to a baseline of 4,331 households, with consistent representation of regions, rural and urban areas, main income sources, income levels and gender of the household head.

Urban/rural areas

Rural areas in Guinea are inhabited by 3.50 million people, corresponding to 70 percent of the total population. Food insecurity in rural Guinea was already an issue before Ebola. In 2013, an estimated 774,000 people were food insecure in rural areas, which is three times the 224,000 food-insecure people in urban areas. With the rapid spread of Ebola, falling wages and rising prices, this difference is expected to have increased. According to the simulation, in H1-2015, rural food insecurity will affect 1.76 million people (20%), while the urban food insecure will number 381,000 (10%). This difference will persist with the assumed price increases in Q3-2015. Food insecurity in both urban and rural areas is expected to deteriorate at the same pace, with an increase of around 11 percentage points. The rural food-insecure population is expected to reach 2.79 million – 78 percent of all food-insecure people in Guinea.

Figure 24: Proportion of food-insecure people in Guinea (by urban/rural area), 2013 – 2015



Region

The data used in the simulation show a clear food insecurity pattern for many regions of Guinea.

Kindia and Labé are the poorest regions. Food insecurity is estimated to have affected 20 percent of the population in Kindia before Ebola. In this region, petty trade and private activity are the two main source of income, followed by crop selling. The effects of Ebola will push the proportion of food insecure up to 48 percent in Q3-2015. A faster growth of food insecurity is also expected in Labé, which is prone to price shocks considering its dependency on imports from N'Zérékoré.

The capital city region, Conakry, has been affected by Ebola discontinuously and the number of cases stayed mostly under 20 a week. The impact on food security should remain low in H1-2015, when the number of food insecure is estimated to be 8 percent. A surge is expected in Q3-2015, when 22 percent will be food insecure people because of the assumed price increase and heavy reliance on food markets.

N'Zérékoré is expected to be one of the more food-secure regions, despite its high case incidence. According to the baseline data, households in this district mostly rely on their own food production and have the highest level of income and spend the lowest proportion of their income on food. In Q3-2015, the proportion of food-insecure people is expected to be 19 percent – one of the lowest in the country.

Figure 25: Proportion of food-insecure people in Guinea (by region), 2013 – 2015

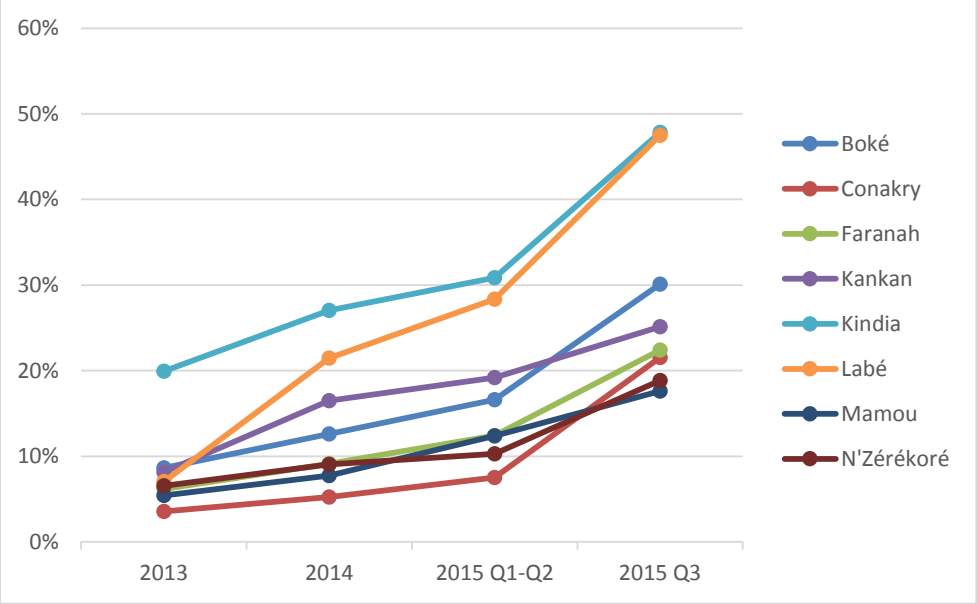
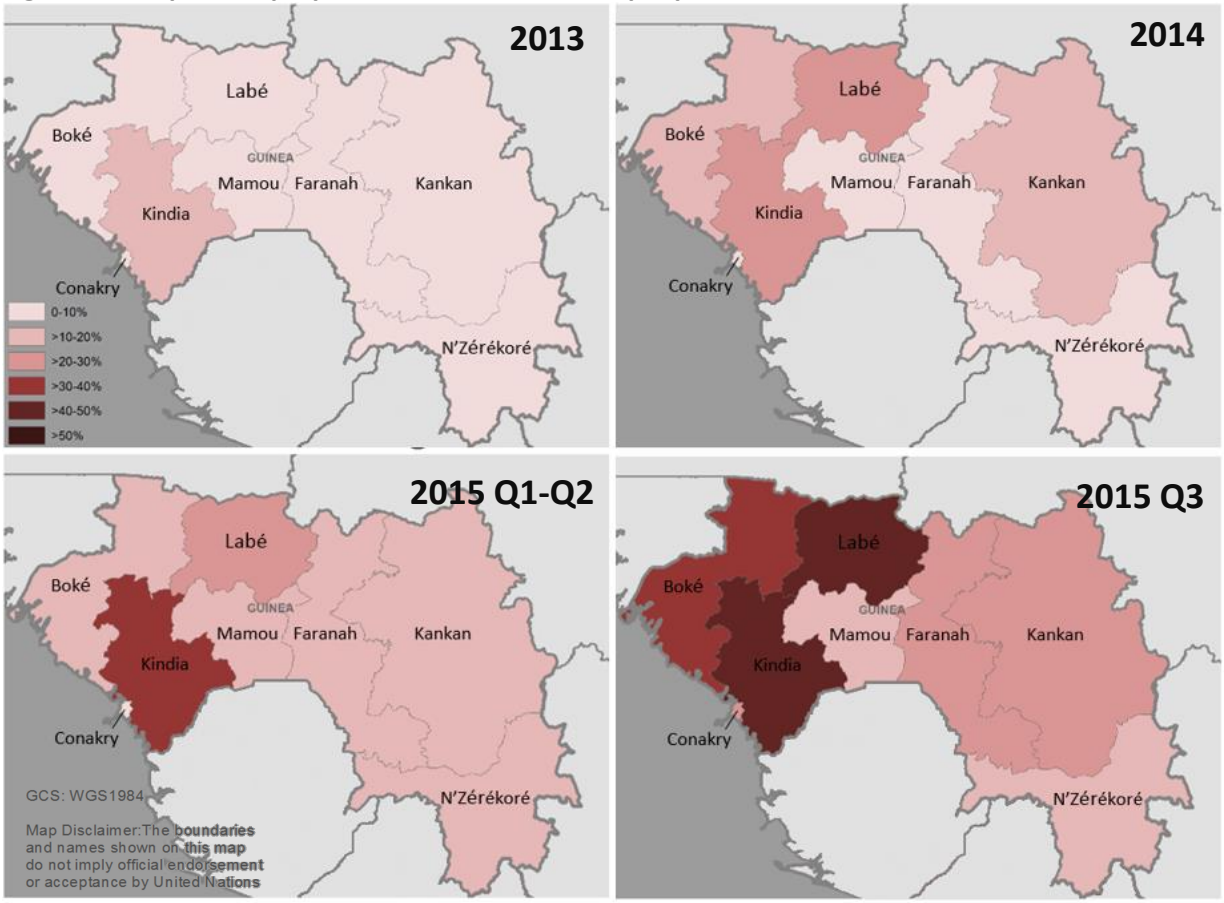


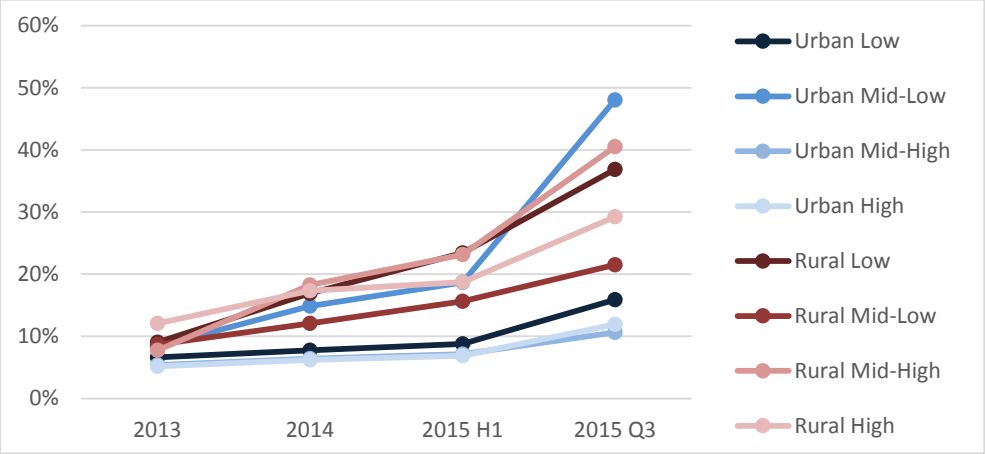
Figure 26: Map of the proportions of food-insecure people in Guinea, 2013 – 2015



Income level

Urban households face less insecurity than rural ones, except the mid-low income quartile of the population. These households are expected to suffer more than other urban ones because they rely on markets and engage in private activities that are reported to have suffered from falling demand and increasing unemployment. The proportion of food-insecure people in the mid-low income quartile group in urban areas is estimated to have been 8 percent in 2013, jumping to 48 percent in Q3-2015, surpassing all the other groups. A similar trend is expected among rural families with mid-high incomes, with a smaller peak at 41 percent in Q3-2015. This can be explained generally if we consider that on average, middle-income families depend more on markets to meet their food needs; if their income drops, food price increases can push many of them into food insecurity.

Figure 27: Proportion of food-insecure people in Guinea (by urban/rural area and income quartile), 2013 – 2015

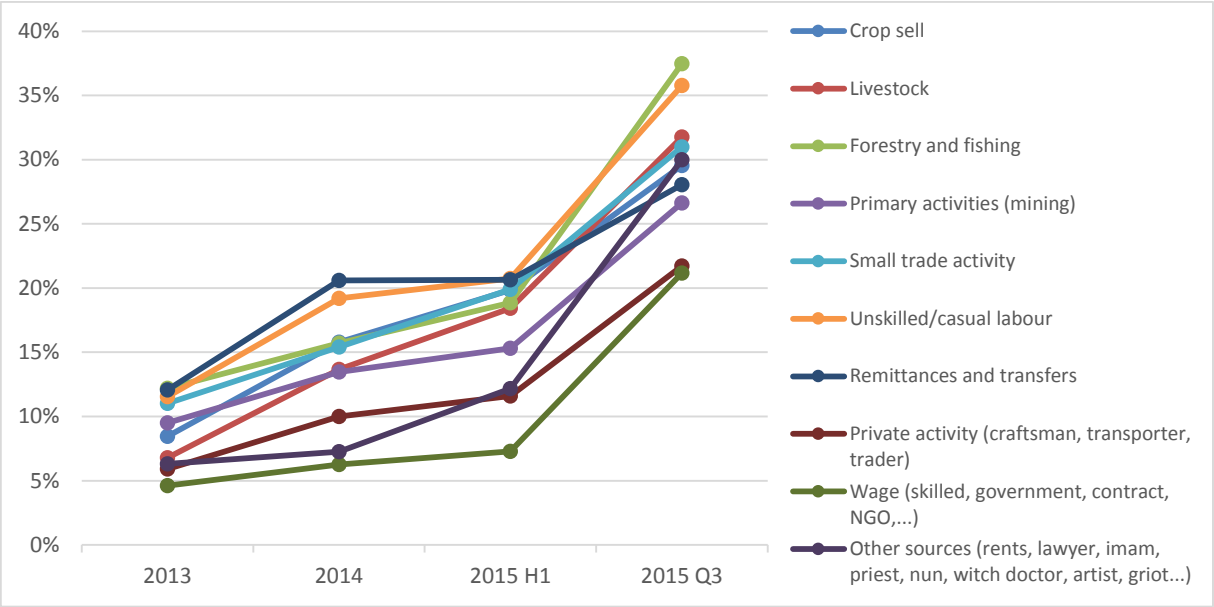


Livelihood

Forestry and fishing, and unskilled/casual labour are expected to be the two income source groups facing the most difficulties. Their proportion of food insecure would grow from relatively high levels of 12 percent in 2013 to a record high of 37 percent in Q3-2015. For those selling crops and engaging in small trade activities – the largest livelihood groups – the food insecure would reach 30 percent for crop sellers and 31 percent for small traders in Q3-2015.

The simulation found waged activities as the most resilient. Nonetheless, there are reports of unemployment among wage earners in urban areas because of the economic contraction caused by Ebola (UNDP, 2014). This translates into a fall in food security affecting 21 percent of this population group in the Q3-2015.

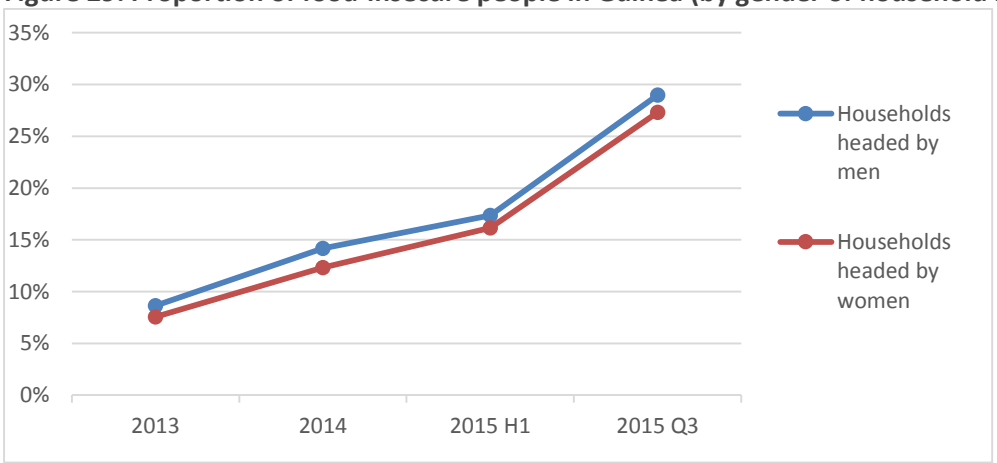
Figure 28: Proportion of food-insecure people in Guinea (by main source of income), 2013 – 2015



Gender

The baseline data indicates that although the income of households headed by women is 2 percent less than that of households headed by men, their food expenditure is 30 percent higher. This significantly higher food expenditure lowers the proportion of food-insecure households headed by women by just 1 or 2 percentage points compared with that of households headed by men over the three years analysed. This small difference can be explained by the urban-rural distribution within the two groups. Around 54 percent of households headed by women live in urban areas, while only 26 percent of households headed by men are in urban areas. The generally higher food prices in urban areas explain the higher food expenditures of households headed by women. The gender difference in rates of food insecurity in Boké, Kindia and Labé is marked, with a differential effect of +4 to +6 percent for households headed by women. This underlines how disadvantaged these households are in these regions.

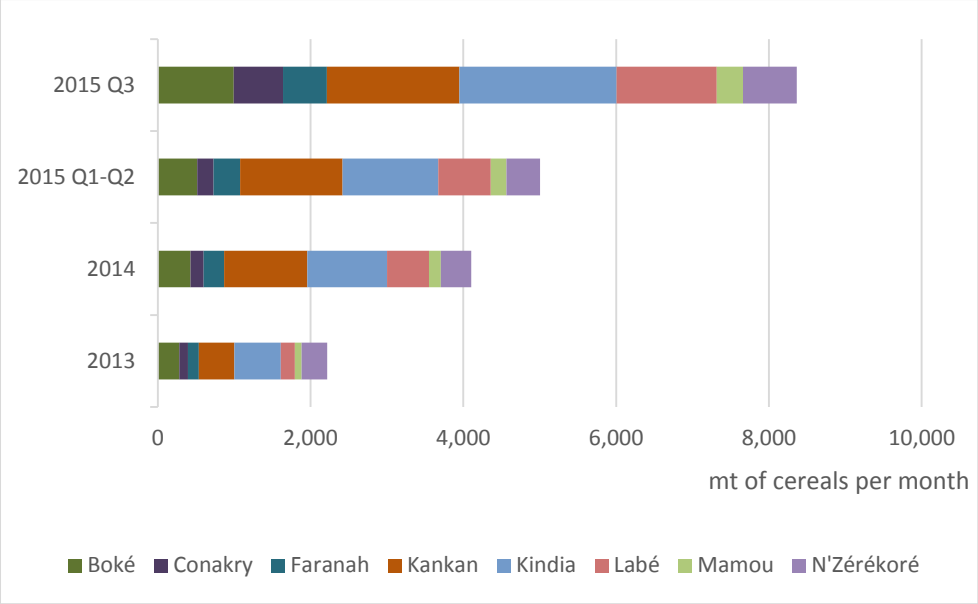
Figure 29: Proportion of food-insecure people in Guinea (by gender of household head), 2013 – 2015



Food shortfall

Data in our simulation indicates that in 2013, the food shortfall faced by the food-insecure population those consuming less than 1,500 kcal per day would have been met by 2,217 mt a month. The income decrease assumed in H1-2015 would increase the shortfall, particularly in Faranah (+31%) and Mamou (+32%), to reach a total of 5,004 mt. Rising food prices and general inflation of other essential goods and services will increase the food shortfall still further in Q3-2015 – particularly in Conakry (+201% more than H1-2015) and Boké (+93% more than H1-2015) – resulting in a national shortfall of 8,366 mt a month.

Figure 30: Food shortfall in Guinea (by district), 2013 – 2015



6 Conclusions

This application uses a lighter version of the Shock Impact Simulation Model (SISMod-Light) to estimate the economic impacts of Ebola on food security in terms of the number of people affected and their food shortfall in Sierra Leone, Liberia and Guinea. By disaggregating the simulation results into sub-population groups, the model allows us to profile the vulnerable households, so as to identify possible causes of vulnerability.

The results show that 16 percent of the population in the three Ebola-stricken countries has been food insecure in H1-2015, while almost one fourth of the population is likely to suffer food insecurity during the lean season in Q3-2015. The food shortfall for the three countries is expected to be at least 12,949 mt of cereals a month.

The assumed price surge in the lean season, exacerbated by limited household income, is the main factor that will increase overall vulnerability to transitory food insecurity. The impact is particularly pronounced among poor households who live in rural areas and rely most on agriculture.

Based on the simulation results, the following priorities have been made to tackle current food insecurity and respond early to reduce the foreseeable risks in the near future: (1) address current food security gaps through food assistance; (2) improve food crop production, especially in poor rural areas; and (3) increase income-generating activities for the poor households.

The model results are based on assumptions and scenarios. The model should be updated from time to time when new data become available to ensure it reflects the changing situation and provides updated estimates. Data from field assessments, remote collection of phone surveys as well as monitoring of food prices would be useful to update or adjust the assumptions and scenarios made.

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Appendix

Appendix 1: Summary of key data of Sierra Leone CFSVA 2010

	Mean	S.D.
Household Composition		
Household Size	6.37	2.90
Adult Equivalents	5.09	2.34
Female Ratio	0.52	0.19
Dependency Ratio	0.42	0.22
Dummy – Headed by Women	0.22	0.42
Household Monthly Income from (in SLL):		
Sale Of Food Crops	895,138	1,258,570
Sale Of Vegetables and Fruits	81,541	370,444
Sale Of Cash Crops	286,269	717,410
Livestock	58,310	381,463
Other Primary Activities	313,026	1,407,303
Trade	1,054,027	2,046,323
Remittances	99,926	1,153,986
Transfers and Aid	131,893	765,967
Agricultural Wage	73,515	394,106
Non-Agricultural Wage	769,458	2,223,334
Private Service Activities	173,402	957,168
Other Sources	154,128	1,318,238
Total Household Monthly Income	**4,090,633**	**3,897,453**
Household Monthly Food Expenditure on (in SLL):		
Rice	89,058	56,303
Cereals	9,149	15,513
Roots	9,565	13,552
Pulses	11,987	14,927
Vegetables and Fruits	5,975	11,180
Egg and Dairy Products	5,054	12,684
Meat and Fish	30,765	28,297
Oil	28,957	21,263
Sugar	10,850	8,680
Other	10,039	18,719
Total Household Monthly Food Expenditure	**211,401**	**124,819**
Household Monthly Non-Food Expenditure on (in SLL):		
Beverages and Alcohol	5,831	11,541
Health	6,369	8,002
Personal Care	12,005	13,800
Utilities	12,207	16,896
Housing	5,218	16,481
Transportation	18,299	26,452
Communication	12,299	25,232
Recreation	1,065	5,116
Education	8,785	16,809
Clothing	5,122	7,413
Others	7,786	15,680
Total Household Monthly Non-Food Expenditure	**94,985**	**108,228**
Total Household Monthly Expenditure	**306,386**	**213,419**
Number Of Days In The Last 7 Days Consumed:		
Rice	5.90	1.63
Other Cereals	2.35	2.64
Roots	3.01	2.32
CSB Mix	0.25	0.89
Pulses	3.01	2.69
Vegetables	5.59	1.79
Fruits	0.66	1.34
Eggs	0.44	1.27
Dairy Products	0.67	1.71
Meat and Fish	0.63	1.63
Oil	5.80	1.87
Sugar	1.39	2.23
Condiments and Others	6.92	0.57
Household Food Consumption Score (FCS)	**40.09**	**17.68**

Appendix 2: Summary of key data of Liberia CFSVA 2010

	Mean	S.D.
Household Composition		
Household Size	6.01	2.37
Adult Equivalents	3.97	1.42
Dependency Ratio	0.46	0.20
Dummy - Headed by Women	0.23	0.42
Share of Household Monthly Income by Source (in %):		
Food Crop Production	23.70	30.61
Cash Crop Production	6.25	17.96
Palm Oil Production	4.85	15.50
Fishing, Hunting and Gathering	6.26	17.10
Other Primary Activities	9.33	24.07
Unskilled, Casual Labour	7.04	19.99
Skilled Labour, Handicraft	3.92	16.35
Regular Salary from Employer	13.41	29.30
Trade	16.44	28.31
Remittances from Abroad	3.96	15.15
Transfers within the Country	0.62	5.73
Other	4.23	16.97
Household Monthly Food Expenditure on (in LDR):		
Rice	2,213	2,327
Other Cereals and Tubers	2,401	2,448
Leafy Vegetables and Fruits	137	334
Other Vegetables	268	314
Pulses and Eggs	132	281
Meat, Fish and Dairy	1,793	1,575
Oil and Fat	535	598
Sugar	98	203
Total Household Monthly Food Expenditure	**5,476**	**3,905**
Household Monthly Non-Food Expenditure on (in LDR):		
Beverages, Alcohol and Tobacco	210	566
Personal Care	437	726
Health	233	562
Education	577	1,642
Clothing	377	1,148
Transportation	1,169	1,784
Housing and Utilities	796	2,587
Communication	442	1,184
Agricultural Input Cost	328	786
Fishery Input Cost	22	278
Other	762	2,387
Total Household Monthly Non-Food Expenditure	**5,354**	**7,105**
Total Household Monthly Expenditure	**10,830**	**9,487**
Number of Days In The Last 7 Days Consumed :		
Rice	6.64	1.06
Other Cereals	4.85	2.28
Pulses	1.11	1.51
Vegetables and Fruits	3.98	2.66
Avocado	2.51	1.71
Meat, Fish and Dairy	6.60	1.17
Oil and Fat	5.23	2.07
Sugar	1.40	2.00
Household Food Consumption Score (FCS)	**42.46**	**16.97**

Appendix 3: Summary of key data of Guinea CFSVA 2012

	Mean	S.D.
Household Composition		
Household Size	10.36	6.09
Adult Equivalents	7.61	4.50
Female Ratio	0.51	0.15
Dependency Ratio	0.56	0.19
Dummy - Headed by Women	0.14	0.35
Household Monthly Income from (in GNF):		
Sale Of Food Crops	307,733	530,839
Livestock	116,763	318,343
Forestry and Fishing	44,461	298,458
Other Primary Activities	44,673	341,452
Trade	221,028	419,038
Casual Labour	94,742	1,022,344
Non-Agricultural Wage	123,008	838,964
Remittances	49,061	447,032
Private Activities	180,676	749,673
Other Sources	43,038	195,469
Total Household Monthly Income	**1,225,183**	**1,730,265**
Household Monthly Food Expenditure on (in GNF):		
Cereals	277,016	187,525
Roots	22,619	36,662
Legumes	32,656	34,756
Vegetables, Fruit	14,937	17,950
Meat, Fish, Milk Production and Eggs	46,282	42,871
Oil and Fats	58,326	46,634
Sugar and Sweet Production	23,930	22,694
Other Food Items, Condiments	3,018	21,373
Total Household Monthly Food Expenditure	**478,785**	**239,559**
Household Monthly Non-Food Expenditure on (in GNF):		
Alcohol and Tobacco	9,922	20,404
Housing and Utilities	29,845	49,069
Transports	55,641	79,216
Health	33,403	36,552
Education	28,883	40,442
Clothing	37,894	38,522
Other Services and Non-durable Goods	100,007	105,062
Durables and Assets	38,612	96,375
Total Household Monthly Non-Food Expenditure	**334,207**	**247,095**
Total Household Monthly Expenditure	**812,992**	**390,710**
Number of Days In The Last 7 Days Consumed:		
Rice	5.64	1.91
Other Cereals	3.98	2.62
Roots	2.15	2.03
Pulses	2.40	1.70
Vegetables and Fruits	3.85	2.38
Dairy	1.50	2.24
Meat and Fish	2.77	2.55
Oil	5.58	2.01
Sugar	4.22	2.74
Other	6.75	1.01
Household Food Consumption Score (FCS)	**50.15**	**17.32**

Appendix 4: Estimated income, expenditure and broad commodity group price elasticities by urban/rural area and income group of Sierra Leone

Urban/rural – income group	Income elasticity of total expenditure	Expenditure elasticity of food expenditure	Broad commodity group price elasticity of food expenditure					
			Food	Health	Housing	Transport and communication	Education	Clothing
Urban								
Low	0.383	0.838	-0.924	0.010	0.018	0.042	-0.011	0.005
Mid-low	0.535							
Mid-high	0.482							
High	0.583							
Rural								
Low	0.501	0.965	-0.991	-0.016	0.021	0.032	-0.009	0.001
Mid-low	0.554							
Mid-high	0.664							
High	0.605							

*Unless indicated otherwise, all coefficients are statistically significant at the 1 percent level. Different levels of significance are denoted as follows: * (5 percent level), ** (10 percent level), ^ (not significant).*

Appendix 5: Estimated food expenditure and price elasticities of food group expenditure in urban areas by income group of Sierra Leone

Quantity	Food expenditure elasticities	Uncompensated (Marshallian) food price elasticity				
		Cereals and tubers	Pulses	Vegetables and fruits	Meat, fish and dairy	Oil and sugar
Urban - Low income group						
Cereals and tubers	0.456	-0.353	-0.008^	-0.031	-0.007^	-0.029*
Pulses	0.537*	-0.109^	-0.446	0.026^	-0.050^	0.031^
Vegetables and fruits	0.885	-0.706	0.025^	0.204	-0.066^	-0.159**
Meat, fish and dairy	2.932	-1.307	-0.159	-0.082	-0.863	-0.370
Oil and sugar	1.269	-0.498	-0.034**	-0.039	-0.029^	-0.575
Urban - Mid-low income group						
Cereals and tubers	0.242	-0.220	0.001^	-0.012*	0.005^	-0.009^
Pulses	1.101	-0.419	-0.632	-0.028^	-0.007^	0.052^
Vegetables and fruits	-0.031^	-0.043^	0.014^	0.229	-0.083**	-0.015^
Meat, fish and dairy	3.308	-1.511	-0.128	-0.124	-0.910	-0.511
Oil and sugar	1.114	-0.455	0.014^	-0.039	-0.066	-0.531
Urban - Mid-high income group						
Cereals and tubers	0.430	-0.346	-0.005^	-0.017	-0.022	-0.003^
Pulses	2.148	-0.901	-0.538	-0.117	-0.323	-0.187*
Vegetables and fruits	0.594*	-0.312*	-0.094^	-0.103^	0.017^	-0.141^
Meat, fish and dairy	2.318	-1.002	-0.115	-0.059	-0.742	-0.329
Oil and sugar	1.106	-0.341	0.005^	-0.044	-0.076	-0.597
Urban - High income group						
Cereals and tubers	0.289	-0.227	-0.014	-0.002^	-0.020	-0.018
Pulses	1.594	-0.678	-0.636	-0.015^	-0.112	-0.022^
Vegetables and fruits	0.888	-0.275	0.022^	-0.287	-0.080*	-0.151
Meat, fish and dairy	2.487	-1.002	-0.082	-0.101	-0.826	-0.301
Oil and sugar	1.136	-0.411	0.019*	-0.054	-0.062	-0.584

*Unless indicated otherwise, all coefficients are statistically significant at the 1 percent level. Different levels of significance are denoted as follows: * (5 percent level), ** (10 percent level), ^ (not significant).*

Appendix 6: Estimated food expenditure and price elasticities of food group expenditure in rural areas by income group of Sierra Leone

Quantity	Food Expenditure Elasticities	Uncompensated (Marshallian) food price elasticity				
		Cereals and tubers	Pulses	Vegetables and fruits	Meat, fish and dairy	Oil and sugar
Rural - Low income group						
Cereals and tubers	0.921	-0.651	-0.073	-0.032	0.022^	-0.115
Pulses	2.083	-1.275	-0.592	-0.062**	-0.191*	0.078^
Vegetables and fruits	0.402^	-0.836	-0.135^	0.879	0.058^	-0.283*
Meat, fish and dairy	1.782	-0.367	-0.045**	-0.015**	-0.990	-0.309
Oil and sugar	0.717	-0.155	0.092	-0.023	-0.052*	-0.553
Rural - Mid-low income group						
Cereals and tubers	0.751	-0.583	-0.028	-0.026	-0.011^	-0.055
Pulses	1.137	-0.493	-0.443	0.056**	-0.129^	-0.108^
Vegetables and fruits	-0.374^	-0.360**	0.264*	0.611	0.242*	-0.303**
Meat, fish and dairy	1.596	-0.468	-0.057*	-0.009^	-0.860	-0.151
Oil and sugar	1.229	-0.383	-0.029^	-0.043	-0.065	-0.654
Rural - Mid-high income group						
Cereals and tubers	0.610	-0.477	-0.025	-0.021	-0.006^	-0.036
Pulses	1.424	-0.677	-0.532	-0.015^	-0.132^	0.013^
Vegetables and fruits	0.200^	-0.608**	0.005^	0.664	0.160^	-0.326^
Meat, fish and dairy	2.259	-0.873	-0.082	-0.015^	-0.918	-0.292
Oil and sugar	1.060	-0.323	0.022^	-0.032	-0.039**	-0.627
Rural - High income group						
Cereals and tubers	0.547	-0.448	-0.028	-0.021	-0.005^	-0.038*
Pulses	1.379	-0.682	-0.510	-0.068**	-0.035^	-0.029^
Vegetables and fruits	-0.960^	0.076^	-0.117^	0.812	0.157^	0.176^
Meat, fish and dairy	2.489	-0.999	-0.073*	-0.039*	-0.879	-0.389
Oil and sugar	0.993	-0.318	0.014^	-0.017^	-0.057**	-0.561

*Unless indicated otherwise, all coefficients are statistically significant at the 1 percent level. Different levels of significance are denoted as follows: * (5 percent level), ** (10 percent level), ^ (not significant).*

Appendix 7: Estimated income and expenditure elasticities by county of Liberia

County	Income elasticity of total expenditure	Total expenditure elasticity of food expenditure
Monrovia	1.000 (assumed to be unit elastic, since the income data in actual terms is not available)	0.669
Bomi		0.801
Bong		0.699
Grand Bassa		0.648
Grand Cape Mount		0.739
Grand Gedeh		0.721
Grand Kru		0.648
Lofa		0.603
Margibi		0.737
Maryland		0.591
Montserrado		0.750
Nimba		0.708
River Cess		0.754
Sinoe		0.483
River Gee		0.704
Gbapolu		0.600

*Unless indicated otherwise, all coefficients are statistically significant at the 1 percent level. Different levels of significance are denoted as follows: * (5 percent level), ** (10 percent level), ^ (not significant).*

Appendix 8: Estimated food expenditure and food price elasticities in urban areas by income group of Liberia

Quantity	Food expenditure elasticity	Uncompensated (Marshallian) food price elasticity							
		Rice	Other cereals and tubers	Pulses and eggs	Vegetables and fruits	Other vegetables	Meat and fish	Oil and fat	Sugar
Urban - Low income group									
Rice	0.985	-0.851	0.163	-0.013 **	-0.049	-0.011 ^	-0.083	-0.046	-0.090
Other cereals and tubers	1.119	0.095	-0.867	-0.017 *	0.003 ^	-0.049	-0.186	-0.055	-0.091
Pulses and eggs	1.662	-0.522	-0.570	-0.150 **	-0.021 ^	0.155 **	-0.639	-0.374	0.195 **
Vegetables and fruits	1.071	-0.795	0.078 ^	-0.004 ^	-0.241	0.141 *	-0.214 **	-0.170 *	0.106 ^
Other vegetables	0.410 *	0.165 *	-0.070 ^	0.097 *	0.087	-0.604	0.107 ^	0.015 ^	0.029 ^
Meat and fish	0.744	-0.016 ^	-0.114	-0.030	-0.011 ^	0.001 ^	-0.460	-0.004 ^	-0.009 ^
Oil and fat	0.731	-0.085 **	-0.075 **	-0.068 *	-0.037 **	-0.010 ^	-0.007 ^	-0.484	0.143
Sugar	1.000	-4.771	-5.090	0.227 ^	0.070 ^	-0.199 ^	-1.731 *	0.482 ^	3.110
Urban - Middle income group									
Rice	0.958	-0.799	0.150	0.000 ^	-0.026	-0.015	-0.134	-0.022	-0.095
Other cereals and tubers	0.989	0.124	-0.829	0.005 ^	-0.004 ^	-0.031	-0.134	-0.037	-0.079
Pulses and eggs	2.129	-0.483	-0.442	-0.325	-0.044 ^	-0.062 ^	-0.935	-0.236	-0.048 ^
Vegetables and fruits	0.915	-0.304	-0.017 ^	-0.004 ^	-0.235	0.039 ^	-0.249 *	-0.232	0.120 ^
Other vegetables	0.697	-0.012 ^	-0.131	0.008 ^	0.031 ^	-0.526	0.059 ^	-0.021 ^	0.013 ^
Meat and fish	0.713	-0.082	-0.076	-0.049	-0.020 *	0.010 ^	-0.389	-0.025 *	0.031 *
Oil and fat	0.990	-0.104	-0.169	-0.036 *	-0.079	-0.027 **	-0.161	-0.427	0.016 ^
Sugar	1.000	-4.508	-4.518	-0.207 ^	0.042 ^	-0.270 **	-1.218 *	-0.453 **	2.458
Urban - High income group									
Rice	0.762	-0.684	0.208	-0.006 ^	-0.020	-0.005 ^	-0.080	-0.011 **	-0.083
Other cereals and tubers	0.806	0.172	-0.685	0.005 ^	0.000 ^	-0.016	-0.117	-0.030	-0.068
Pulses and eggs	1.676	-0.386	-0.288	-0.362	-0.083	-0.098 *	-0.622	-0.073 **	0.005 ^
Vegetables and fruits	1.287	-0.340	-0.187 **	-0.050 ^	-0.320	-0.018 ^	-0.443	-0.110 *	0.083 ^
Other vegetables	1.143	-0.171	-0.250	-0.044 **	-0.009 ^	-0.512	-0.103 *	-0.101	-0.003 ^
Meat and fish	0.849	-0.115	-0.153	-0.035	-0.040	-0.001 ^	-0.429	-0.039	0.015 ^
Oil and fat	1.011	-0.129	-0.202	-0.003 ^	-0.039 *	-0.049	-0.190	-0.409	0.006 ^
Sugar	1.000	-4.387	-4.550	-0.249 *	-0.174 ^	-0.440	-2.534	-0.760	1.269

*Unless indicated otherwise, all coefficients are statistically significant at the 1 percent level. Different levels of significance are denoted as follows: * (5 percent level), ** (10 percent level), ^ (not significant).*

Appendix 9: Estimated food expenditure and food price elasticities in rural areas by income group of Liberia

Quantity	Food Expenditure Elasticity	Uncompensated (Marshallian) food price elasticity							
		Rice	Other cereals and tubers	Pulses and eggs	Vegetables and fruits	Other vegetables	Meat and fish	Oil and fat	Sugar
Rural - Low income group									
Rice	0.418	-0.746	0.391	-0.008 ^	-0.040 **	-0.012 ^	0.219	0.037 ^	-0.158
Other cereals and tubers	0.900	0.242	-0.680	-0.024 ^	-0.014 ^	-0.017 ^	-0.251	-0.014	-0.123
Pulses and eggs	0.734 **	-0.208 ^	-0.328 ^	0.302 ^	0.341 *	0.938	-0.569 ^	-0.384 **	-0.781
Vegetables and fruits	-0.087 ^	-1.044 *	-0.159 ^	0.695 *	3.670	0.450 ^	-1.397 **	-0.244 ^	-1.698
Other vegetables	0.895	-0.170 *	-0.059 ^	0.218	0.044 ^	-0.503	0.025 ^	-0.106 ^	-0.326
Meat and fish	1.004	0.000 ^	-0.218	-0.032 *	-0.044	-0.003 ^	-0.638	-0.157	0.089 *
Oil and fat	1.140	-0.113 *	-0.099 **	-0.063 **	-0.029 ^	-0.084 **	-0.521	-0.168 *	-0.087 ^
Sugar	1.000	-4.080	-3.768	-0.756	-0.744	-1.704	-1.567 ^	-1.446	3.677
Rural - Middle income group									
Rice	0.865	-0.744	0.211	-0.019	-0.020	-0.028	-0.106	-0.008 ^	-0.103
Other cereals and tubers	0.847	0.204	-0.803	-0.011 **	0.002 ^	0.007 ^	-0.059	-0.058	-0.077
Pulses and eggs	0.716 *	-0.337 *	-0.180 ^	-0.098 ^	0.002 ^	-0.036 ^	0.072 ^	0.056 ^	-0.095 ^
Vegetables and fruits	-0.025 ^	-0.331 ^	0.432 *	0.017 ^	1.144	-0.149 ^	-0.199 ^	-0.587	0.059 ^
Other vegetables	1.363	-0.408	-0.151 *	-0.026 ^	-0.050 ^	-0.614	-0.298	-0.004 ^	0.061 ^
Meat and fish	0.854	-0.114	-0.073	0.001 ^	-0.016 *	-0.017 *	-0.540	-0.045	0.002 ^
Oil and fat	1.223	-0.169	-0.379	0.000 ^	-0.077	0.005 ^	-0.275	-0.527	0.119 *
Sugar	1.000	-4.527	-4.337	-0.216 **	-0.056 ^	-0.171 ^	-2.350	-0.085 ^	1.674
Rural - High income group									
Rice	0.916	-0.778	0.192	-0.023	-0.026	-0.008 ^	-0.132	-0.018 *	-0.090
Other cereals and tubers	1.016	0.137	-0.817	-0.013	-0.020	-0.011 *	-0.189	-0.038	-0.070
Pulses and eggs	0.950	-0.497	-0.261 *	-0.178 **	0.073 ^	0.017 ^	-0.165 ^	-0.111 ^	0.191 *
Vegetables and fruits	0.385 ^	-0.476	-0.294 **	0.101 ^	0.701	0.039 ^	-0.050 ^	-0.216 *	0.045 ^
Other vegetables	1.297	-0.230	-0.237	0.001 ^	-0.001 ^	-0.529	-0.367	-0.127	0.079 **
Meat and fish	0.718	-0.077	-0.112	-0.005 ^	-0.007 ^	-0.022	-0.374	-0.034	0.022 *
Oil and fat	0.714	0.002 ^	-0.047 ^	-0.018 ^	-0.041	-0.035 **	-0.124 *	-0.341	0.001 ^
Sugar	1.000	-4.832	-4.764	0.040 ^	-0.089 ^	-0.138 ^	-2.242	-0.706	1.580

*Unless indicated otherwise, all coefficients are statistically significant at the 1 percent level. Different levels of significance are denoted as follows: * (5 percent level), ** (10 percent level), ^ (not significant).*

Appendix 10: Estimated income elasticities by urban/rural area and income group of Guinea

Urban/rural – income Group	Income elasticity of total expenditure
Urban	
Low	0.796
Mid-low	0.699
Mid-high	0.260
High	0.127
Rural	
Low	1.096
Mid-low	0.810
Mid-high	0.599
High	0.242

*Unless indicated otherwise, all coefficients are statistically significant at the 1 percent level. Different levels of significance are denoted as follows: * (5 percent level), ** (10 percent level), ^ (not significant).*

Appendix 11: Estimated expenditure and broad commodity group price elasticities in urban areas by income group of Guinea

Quantity	Expenditure elasticity	Broad commodity group price elasticity of food expenditure							
		Food	Housing	Alcohol and tobacco	Food	Health	Education	Food	Asset
Urban - Low income group									
Food	0.611	-0.506	-0.030	-0.002	-0.032	-0.023	-0.027	-0.017	-0.015
Housing	2.333	-1.075	0.194	-0.008	-0.122	-0.088	-0.103	-0.063	-0.056
Alcohol and tobacco	0.096	-0.044	-0.005	-0.750	-0.005	-0.004	-0.004	-0.003	-0.002
Transports	1.446	-0.667	-0.072	-0.005	-0.266	-0.055	-0.064	-0.039	-0.035
Health	0.960	-0.442	-0.048	-0.003	-0.050	-0.096	-0.042	-0.026	-0.023
Education	1.842	-0.849	-0.091	-0.006	-0.096	-0.070	0.329	-0.050	-0.044
Clothing	0.837	-0.386	-0.042	-0.003	-0.044	-0.032	-0.037	-0.457	-0.020
Assets	0.665	-0.307	-0.033	-0.002	-0.035	-0.025	-0.029	-0.018	-0.501
Urban – Lower middle income group									
Food	0.675	-1.532	0.079	-0.003	0.116	0.022	0.044	0.054	0.123
Housing	1.822	0.962	-3.861	-0.008	0.313	0.059	0.120	0.146	0.333
Alcohol and tobacco	0.046	0.024	0.005	-0.658	0.008	0.002	0.003	0.004	0.008
Transports	1.424	0.751	0.166	-0.007	-3.425	0.046	0.093	0.114	0.260
Health	0.713	0.377	0.083	-0.003	0.123	-1.784	0.047	0.057	0.130
Education	1.504	0.794	0.175	-0.007	0.259	0.049	-3.006	0.120	0.275
Clothing	0.918	0.485	0.107	-0.004	0.158	0.030	0.060	-2.592	0.168
Assets	1.723	0.910	0.201	-0.008	0.296	0.056	0.113	0.138	-4.597
Urban – Higher middle income group									
Food	0.603	-0.416	-0.044	-0.005 ^	-0.040	-0.022	-0.028 ^	-0.016	0.009 **
Housing	1.403	-0.758	0.825	-0.011	-0.094	-0.052	-0.065 ^	-0.037	0.022 **
Alcohol and tobacco	0.126	-0.068	-0.009	-0.421	-0.008	-0.005 **	-0.006 ^	-0.003	0.002 ^
Transports	1.273	-0.688	-0.093	-0.010	-0.048	-0.047	-0.059 ^	-0.034	0.020 **
Health	1.142	-0.617	-0.083	-0.009 ^	-0.076	-0.121	-0.053 ^	-0.030	0.018 **
Education	1.943	-1.050	-0.142	-0.015 ^	-0.130	-0.072	0.403 **	-0.051	0.030 **
Clothing	0.733	-0.396	-0.054	-0.006 ^	-0.049	-0.027 **	-0.034 ^	-0.470	0.011 **
Assets	4.466	-2.413	-0.326	-0.035 **	-0.298	-0.165	-0.208 ^	-0.118	-1.265 **
Urban – High middle income group									
Food	0.520	-0.252	-0.042	-0.001 ^	-0.037	-0.019	-0.030	-0.020	0.027 *
Housing	1.961	-1.262	0.976	-0.002 ^	-0.140	-0.073	-0.113	-0.076	0.101 **
Alcohol and tobacco	1.394	-0.897	-0.113	-0.924	-0.099	-0.052	-0.080	-0.054	0.072 **
Transports	1.263	-0.813	-0.102	-0.001 ^	0.018 ^	-0.047	-0.073	-0.049	0.065 **
Health	1.050	-0.676	-0.085	-0.001 ^	-0.075	-0.115 ^	-0.061	-0.041	0.054 **
Education	0.440	-0.283	-0.036	0.000 ^	-0.031	-0.016	0.824	-0.017	0.023 **
Clothing	0.652	-0.420	-0.053	-0.001 ^	-0.047	-0.024	-0.038	-0.221 **	0.034 **
Assets	4.377	-2.818	-0.354	-0.005 ^	-0.312	-0.163	-0.252	-0.169	-1.880

*Unless indicated otherwise, all coefficients are statistically significant at the 1 percent level. Different levels of significance are denoted as follows: * (5 percent level), ** (10 percent level), ^ (not significant).*

Appendix 12: Estimated expenditure and broad commodity group price elasticities in rural areas by income group of Guinea

Quantity	Expenditure elasticity	Broad commodity group price elasticity of food expenditure							
		Food	Housing	Alcohol and tobacco	Transports	Health	Education	Clothing	Assets
Rural - Low income group									
Food	1.269	-0.809	-0.013	-0.012	-0.039	-0.035	-0.021	-0.044	-0.037
Housing	0.281	-0.130	-0.742	-0.003	-0.009	-0.008	-0.005	-0.010	-0.008
Alcohol and tobacco	1.014	-0.468	-0.010	-0.290	-0.031	-0.028	-0.017	-0.035	-0.030
Transports	0.322	-0.149	-0.003	-0.003	-0.527	-0.009	-0.005	-0.011	-0.009
Health	0.751	-0.347	-0.007	-0.007	-0.023	-0.338	-0.012	-0.026	-0.022
Education	0.322	-0.149	-0.003	-0.003	-0.010	-0.009	-0.474	-0.011	-0.009
Clothing	0.847	-0.391	-0.008	-0.008	-0.026	-0.023	-0.014	-0.309	-0.025
Assets	0.551	-0.255	-0.005	-0.005	-0.017	-0.015	-0.009	-0.019	-0.390
Rural – Lower middle income group									
Food	1.243	-0.401	-0.033	-0.034	-0.105	-0.088	-0.031	-0.111	-0.076
Housing	0.341	-0.465	-0.299	-0.009	-0.029	-0.024	-0.009	-0.031	-0.021
Alcohol and tobacco	1.050	-1.430	-0.028	1.022	-0.089	-0.074	-0.026	-0.094	-0.065
Transports	0.598	-0.814	-0.016	-0.017	0.266 *	-0.042	-0.015	-0.054	-0.037
Health	0.841	-1.145	-0.023	-0.023	-0.071	0.700	-0.021	-0.075	-0.052
Education	0.223	-0.304	-0.006	-0.006	-0.019	-0.016	-0.201	-0.020	-0.014
Clothing	0.858	-1.169	-0.023	-0.024	-0.073	-0.061	-0.022	0.788	-0.053
Assets	0.531	-0.723	-0.014	-0.015	-0.045	-0.038	-0.013	-0.048	0.285
Rural – Higher middle income group									
Food	1.137	-1.543	0.031	0.025	0.047	0.047	0.006 ^	0.089	0.026 *
Housing	0.488	0.485	-1.713	0.011	0.020	0.020	0.003 ^	0.038	0.011 *
Alcohols and tobaccos	1.183	1.176	0.033	-2.582	0.049	0.049	0.006 ^	0.092	0.027 *
Transports	0.620	0.617	0.017	0.013	-1.622	0.026	0.003 ^	0.048	0.014 *
Health	0.824	0.819	0.023	0.018	0.034	-1.994	0.004 ^	0.064	0.019 *
Education	0.347	0.344	0.010	0.008	0.014 *	0.014	-1.169	0.027	0.008 *
Clothing	1.186	1.179	0.033	0.026	0.050	0.049	0.006 ^	-2.528	0.027 *
Assets	0.598	0.594	0.016	0.013	0.025 *	0.025	0.003 ^	0.047	-1.474
Rural – High middle income group									
Food	0.962	-1.147	0.006 ^	0.036	0.114	0.005 ^	-0.017	0.028	0.019 *
Housing	0.451	0.092	-1.164	0.017	0.053	0.002 ^	-0.008	0.013	0.009 *
Alcohols and tobaccos	2.741	0.560	0.017 ^	-3.640	0.325	0.014 ^	-0.047	0.079	0.054 *
Transports	1.861	0.380	0.012 ^	0.069	-2.622	0.009 ^	-0.032	0.054	0.037 *
Health	0.739	0.151	0.005 ^	0.027	0.088	-1.120	-0.013	0.021	0.015 *
Education	0.031 ^	0.006 ^	0.000 ^	0.001 ^	0.004 ^	0.000 ^	-0.449	0.001 ^	0.001 ^
Clothing	1.225	0.250	0.008 ^	0.045	0.145	0.006 ^	-0.021	-1.564	0.024 *
Assets	1.072	0.219	0.007	0.040 ^	0.127	0.005 ^	-0.018	0.031	-1.402

*Unless indicated otherwise, all coefficients are statistically significant at the 1 percent level. Different levels of significance are denoted as follows: * (5 percent level), ** (10 percent level), ^ (not significant).*

Appendix 13: Estimated food expenditure and price elasticities of food group expenditure in urban areas by income group of Guinea

Quantity	Food expenditure elasticity	Uncompensated (Marshallian) food price elasticity					
		Cereals and tubers	Pulses	Vegetables and fruits	Proteins	Oil, fat and sugar	Other
Urban - Low income group							
Cereals and tubers	1.007	-0.733	-0.050	-0.028	-0.052	-0.105	-0.039
Pulses	0.899 *	-0.504 *	-0.390	-0.041 ^	0.271	-0.194 **	-0.041 ^
Vegetables and fruits	0.548 *	-0.142 ^	-0.036 ^	-0.640	0.160 *	0.103 **	0.006 ^
Proteins	0.840	-0.256	0.167	0.060	-0.709	-0.171	0.069
Oil, fat and sugar	1.155	-0.431 **	-0.069	-0.003 *	-0.108	-0.523 *	-0.021 ^
Other	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Urban – Lower middle income group							
Cereals and tubers	1.023	-0.689	-0.050	-0.022	-0.057	-0.120	-0.085
Pulses	1.256	-0.704	-0.651	0.033 ^	0.275	-0.029 ^	-0.180 *
Vegetables and fruits	0.738	-0.125 ^	0.066 ^	-0.607	-0.003 ^	-0.021 ^	-0.047 ^
Proteins	1.041	-0.382	0.173	-0.015 ^	-0.715	-0.075 ^	-0.026 ^
Oil, fat and sugar	0.871	-0.255	0.013 ^	-0.011 ^	-0.018 ^	-0.527	-0.074 *
Other	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Urban – Higher middle income group							
Cereals and tubers	1.136	-0.764	-0.058	-0.048	-0.065	-0.149	-0.051
Pulses	0.877	-0.466	-0.556	-0.005 ^	0.234	-0.044 ^	-0.039 *
Vegetables and fruits	0.205 ^	-0.064 **	0.031 ^	-0.359	0.025 ^	0.076 ^	0.086 ^
Proteins	0.849	-0.239	0.140	-0.018	-0.653	-0.089	0.010
Oil, fat and sugar	0.951	-0.329	-0.016	-0.017	-0.051	-0.470	-0.067
Other	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Urban – High middle income group							
Cereals and tubers	1.096	-0.781	-0.057	-0.040	-0.056	-0.129	-0.033
Pulses	0.943	-0.518	-0.569	-0.014 ^	0.298	-0.071 ^	-0.069 **
Vegetables and fruits	0.451 *	-0.196 *	0.008 ^	-0.591	0.058 ^	0.250 *	0.020 ^
Proteins	1.038	-0.324	0.173	0.001 ^	-0.692	-0.152 *	-0.044 **
Oil, fat and sugar	0.904	-0.286 ^	-0.018 *	0.034 *	-0.061	-0.481	-0.093
Other	1.000	1.000	1.000	1.000	1.000	1.000	1.000

*Unless indicated otherwise, all coefficients are statistically significant at the 1 percent level. Different levels of significance are denoted as follows: * (5 percent level), ** (10 percent level), ^ (not significant).*

Appendix 14: Estimated food expenditure and price elasticities of food group expenditure in rural areas by income group of Guinea

Quantity	Food expenditure elasticity	Uncompensated (Marshallian) food price elasticity					
		Cereals and tubers	Pulses	Vegetables and Fruits	Cereals and tubers	Oil, Fat and Sugar	Other
Rural - Low income group							
Cereals and tubers	1.007	-0.716	-0.053	-0.030	-0.055	-0.112	-0.041
Pulses	0.924	-0.379 *	-0.543	-0.031 ^	0.203	-0.143 **	-0.030 ^
Vegetables and fruits	0.347 ^	-0.230 ^	-0.040 ^	-0.488	0.237 *	0.162 **	0.012 ^
Proteins	0.853	-0.241 **	0.156	0.054 *	-0.731	-0.155 *	0.064 **
Oil, fat and sugar	1.141	-0.386	-0.065 *	-0.001 ^	-0.100	-0.569	-0.020 ^
Other	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Rural – Lower middle income group							
Cereals and tubers	1.023	-0.691	-0.051	-0.022	-0.057	-0.119	-0.084
Pulses	1.190	-0.523	-0.745	0.028 ^	0.203	-0.020 ^	-0.134 *
Vegetables and fruits	0.567 **	-0.205 ^	0.117 ^	-0.359	-0.003 ^	-0.039 ^	-0.078 ^
Proteins	1.038	-0.361	0.162	-0.014 ^	-0.731	-0.070 ^	-0.025 ^
Oil, fat and sugar	0.865	-0.265	0.016 ^	-0.014 ^	-0.018 ^	-0.507	-0.077
Other	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Rural – Higher middle income group							
Cereals and tubers	1.139	-0.756	-0.063	-0.047	-0.069	-0.152	-0.052
Pulses	0.914	-0.327	-0.688	-0.005 ^	0.165	-0.031 ^	-0.027 *
Vegetables and fruits	-0.246 **	-0.118 **	0.079 ^	-0.016	0.056 ^	0.108 ^	0.138 ^
Proteins	0.868	-0.210	0.125	-0.018 ^	-0.695	-0.079 ^	0.009 ^
Oil, fat and sugar	0.949	-0.345	-0.016 ^	-0.019 ^	-0.053 ^	-0.447	-0.070 *
Other	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Rural – High middle income group							
Cereals and tubers	1.104	-0.758	-0.064	-0.043	-0.062	-0.142	-0.036
Pulses	0.959	-0.378	-0.687	-0.011 ^	0.217	-0.051 ^	-0.050 **
Vegetables and fruits	0.300 ^	-0.283 *	0.025 ^	-0.485	0.084 ^	0.333	0.026 ^
Proteins	1.033	-0.280	0.150	0.001 ^	-0.733	-0.133 *	-0.038 **
Oil, fat and sugar	0.913	-0.263	-0.015 ^	0.030 *	-0.054 *	-0.528	-0.084
Other	1.000	1.000	1.000	1.000	1.000	1.000	1.000

*Unless indicated otherwise, all coefficients are statistically significant at the 1 percent level. Different levels of significance are denoted as follows: * (5 percent level), ** (10 percent level), ^ (not significant).*

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