Monitoring the effects of changing food prices on food and nutrition security. The Minimum Calorie Expenditure Share (MCES)

Fiorella Picchioni

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Centre for Development, Environment and Policy,
SOAS, University of London

Abstract

The global food crises in 2007-08 re-emphasized the importance of food security and undernutrition in the global policy agenda. In spite of a wide recognition of the socio-economic impacts and ethical importance of guaranteeing food and nutrition security, there are methodological and an interpretative pitfalls in the analysis of food price fluctuations on food and nutrition security. In fact, conflicting views on the “real” impacts of the global food price crises after 2008, stem from the wide reliance on food prices per se to gauge the effects of food price fluctuations on vulnerable population in low-income countries. A key question concerns the extent to which food insecure populations experience food price increases and how far the effects of any food price rises is counteracted by economic and income growth. This suggests that the relationship between food prices and income is critical for food security.

Drawing from literature that questions the computation of real food prices, this PhD develops the Minimum Calorie Expenditure Share (MCES), an intuitively appealing metric for describing short term impacts of volatile food prices on different income groups. This thesis adopts an interdisciplinary approach to inform its methodology, drawing on both the agricultural and nutrition literatures. The empirical study is based on data from 2008-2009 household surveys for Mozambique and Bangladesh. The MCES is evaluated against widely adopted food and nutrition security indicators using linear multivariate regression techniques.

Overall, the results suggest that the MCES (incorporating the interaction between food prices and income) can be more adequate in monitoring and measuring the effects of food price changes on poor population food and nutrition security. Alongside, the thesis also highlights the numerous challenges associated with developing “universal” metrics, urging for intra-disciplinary collaboration directed to the homogenization of protocols and methodological approaches.

Keywords: food prices, food and nutrition security, interdisciplinary approach

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Acronyms and abbreviations

BDHS: Bangladesh Demographic and Health Survey

BHFSNA: Bangladesh Household Food Security and Nutrition Assessment Report

CPI: Consumer Price Index

DDS: Dietary Diversity Score

DHS: Demographic and Health Survey

FANTA: Food and Nutrition Technical Assistance

FAO: Food and Agricultural Organization of the UN

FCS: Food Consumption Score

FFPI: FAO Food Price Index

FFS: Food Frequency Score

FVS: Food Variety Score

GAIN: Global Alliance for Improved Nutrition

GAM: Global Acute Malnutrition

GoB: Government of Bangladesh

HAZ: Height-for-Age Z-Score

HCES: Household Consumption Expenditure Survey

HDDS: Household Dietary Diversity Score

HFIAS: Household Food Insecurity and Access Scale

HH: Household

IFPRI: International Food Policy Institute

IHSN: International Household Survey Network

IOF: Inquérito ao Orçamento Familiar (Household Budget Survey)

MCES: Minimum Calorie Expenditure Share

MDG: Millennium Development Goals

MENA: Middle East and North Africa

MICS: Multiple Indicator Cluster Survey

MMF: Minimum Meals Frequency

MNAR: Missing Not At Random

MUAC: Middle-Upper Arm circumference

MUV: Manufacturers Unit Value

NGO: Non-Governmental Organization

OLS : Ordinary Least Squares

SAFI: Self-Assessed Food Insecurity

SAM: Severe Acute Malnutrition

UNDP: United Nations Development Programme

UNICEF: United Nations Children's Fund

US: United States of America

USAID: United States Agency of International Development

WB: World Bank

WDI: World Bank Development Index

WFP: World Food Programme

WHO: Wold Health Organization

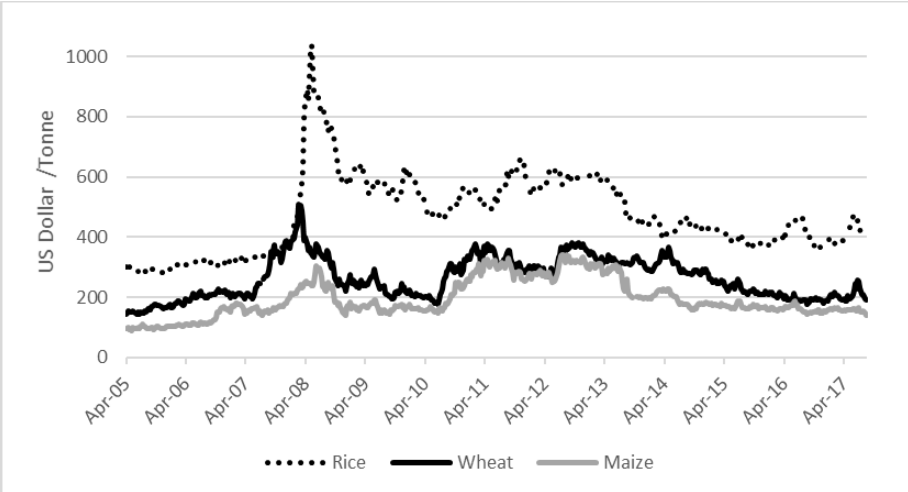
WHZ: Weight-for-Height Z-Score

Chapter 1 Introduction

1.1 Background

Between 2007 and 2008 international prices of staple grains spiked sharply, leading to surges in domestic food prices around the world. The crisis began with the sudden increase of rice quotations on the global market, those of wheat and maize soon followed, increasing by 180 % and 80 % respectively in the same period. Throughout 2009-2012 grain prices remained volatile, causing turmoils and widespread discontent in more than two dozen countries (Barrett 2010). In fact, few countries remained unaffected by the international *food price crisis* (Financial Times 2010), with patterns and degrees of food price fluctuations varying between and within countries. The surge of food price inflation led to violent protests and increased fears about national and international security. Estimates of food-insecure people also increased, with figures exceeding 1 billion hungry in mid-2009 (FAO, 2009).

Figure 1.1Major Food Staple Export Prices (June 2001-March 2014)



Source: FAO Food Prices Monitoring and Analysis tool, September 2017.[1]

World food crises trigger fears on the ability of food systems to provide enough supplies to guarantee food security (Dawe 2010). The food crisis in 2008-2009 re-emphasized the importance of food security and undernutrition in the global policy agenda, raising the worry that global food systems were more unstable than previously thought. Moved by concerns over geo-political instability, different initiatives were launched from various international

[1] Quotation details:Free on board (fob) weekly average export quotations. Rice - Thailand 100% Grade, Bangkok; Wheat- US Hard Red Wheat, Gulf; Maize- US Maize no. 2 yellow, Gulf.

organization and governments. For example, in June 2011 the G20 responded with an action plan on food price volatility and agriculture that addressed increasing concerns on agricultural productivity and excessive agricultural market instability by strengthening transparency, market information and international policy coordination (G20 2011). Among the promoted initiatives there are: the International Research Initiatives for Wheat Improvement (IRIWI); the Agricultural Market Information System (AMIS); The Global Agricultural Geo-Monitoring Initiative; the Rapid Response Forum; and the Agriculture and Food Security Risk Management Toolbox. However, the momentum gradually faded and the interest of policy-makers and international organizations shifted to other issues, such as the global financial crisis. Indeed, international commodity prices started a gradual decline from 2011, but food prices in many low-income countries remained volatile also after the crisis with price levels as high as the ones observed at the peak of the 2008 shock. Therefore, while international prices declined, structural problems of global food systems had not been addressed.

In addition, the food crisis unveiled historical discrepancies on what constitutes the ’right’ levels of food prices (Swinnen 2010) and accentuated conflicting opinions on the effects of recent food price rises on food and nutrition security (Arndt et al. 2016). In fact, the narrative on “damaging” food prices during the period that preceded the food crisis, was focused on the detrimental effects of low prices. After the 2008-2009, the narrative suddenly shifted and in a short time the debate emphasized the negative effects of high food prices.

The 2008-2009 crisis, highlighted dissatisfaction with existing indicators and measures of food insecurity and their capacity to gauge and monitor the impacts of shocks on poor populations’ food insecurity (Dorward 2013; Skoufias et al. 2013; Headey and Ecker 2012). In spite of the wide recognition of the socio-economic impact and the ethical importance of food and nutrition security, the debate over food crises and food insecurity emphasized the lack of agreement on an appropriate and effective way to measure the phenomenon (Skoufias et al. 2013; Headey and Ecker 2012).

Food prices and food price indices are widely used as early warning signals to detect food crises, due to their low cost, immediate availability and evocative power to connect with fears over food scarcity. However, the dependence on real food prices, when *classic* deflators (like the Consumer Price Index – CPI – or the Manufactures Unit Value – MUV) are used for their calculation, may give misleading interpretations about the effects of food price volatility on the welfare of poor populations (Dorward 2013). This is because such deflators are based on parameters pertinent to high-income countries while food insecurity predominantly affects poor populations in poor economies (Dorward 2013). Since food expenditure generally accounts for a higher proportion of poor people's total expenditure, the use of classic price deflators may provide biased information which can underestimate the impact of changes in food prices on poor consumers.

To address these issues, this PhD project, drawing from previous work by Dorward (2013), proposes the Minimum Calorie Expenditure Share (MCES) as an alternative, theoretically grounded and cost-effective food price index that is sensitive to food and nutrition security alterations. This indicator aims to provide a better representation of the effects of food price shocks on poor household's food and nutrition security by measuring the effects of staple food price changes on the ratio of essential calorie requirement expenditure over the total expenditure for different income groups of a population (Dorward 2013). The metric aims at providing valuable information on the impact of changing food prices on food affordability and purchasing power at the household level and, hence, on food and nutrition security in a timely, simple and cost-efficient manner. While the methodology of the MCES potentially allows multiple levels of analysis (from the individual level to the national one), given the nature of the available data, the empirical analyses presented in the thesis do not provide information on the impacts of food price fluctuations on individual nutritional status or intra-household processes that determine individual dietary adequacy. The price indicator does however offer an entry point to refine the analysis of food price fluctuations on food and nutrition security, firstly by allowing a higher disaggregated level of analysis compared to the convention and, secondly, by indicating possible repercussions in terms of individual impact and intra-household mechanisms that mediate food price shocks on food and nutrition security.

Before moving on to the structure of the thesis, it is worth discussing the genesis of this research and the context in which it was developed. This project was financially supported by the Leverhulme Centre on Integrative Research on Agriculture and Health (LCIRAH) that aims at building a novel intersectoral and interdisciplinary platform for integrating research in agriculture, nutrition and health (also known as agri-health), with a focus on international development objectives. As a discipline agri-health promotes the use of interdisciplinary methodologies and collaboration between scholars such as nutritionists, economists, anthropologists, gender studies experts, veterinaries and public health specialists. This PhD draws from previous research undertaken by Andrew Dorward (2013, 2012) and provides empirical analysis to the theoretical framework he proposes using an interdisciplinary approach, in particular at the intersection between agricultural economics, nutrition science and development economics.

Due to the centrality of the empirical work in this thesis, considerations behind the identification of data sources are given fundamental importance. While generally primary data collection is preferred in empirical works, due to a series of unforeseencircumstancesit was not possible to carry out field workand the analysis was therefore conducted solely using secondary data. Particular attention was given to the selection of the specific countries and the identification of the best datasets suited for this exercise. The MCES attempts to be an indicator that is applicable in a wide range of low income countries with concerning levels of undernutrition. It was therefore decided to select two countries that represented different agro-climatic conditions, food production systems but similar nutritional and health related issues. In addition, the choice of the datasets was guided by the methodological aspects of the empirical analysis. In brief, the selected case studies (Mozambique and Bangladesh) typify the socio-economic and nutritional concerns that this PhD is interested in capturing, represent potential contexts where the MCES can be potentially operationalized and offered datasets that included variables and information needed to compute the MCES and perform the empirical analysis[2].

1.2 Structure of the thesis

The thesis begins with a composite review of the literature, developed in Chapter 2, which provides an overview of the debate on the methodological pitfalls in the calculation of real (food) prices, and their ability to usefully elucidate the impact of price fluctuations on food and nutrition security. The chapter reviews selected strands of the literature from the disciplines of agricultural economics and nutrition about the effects of food price increases and economic crises on poverty, wellbeing, food security and nutrition. It concludes by highlighting the difficulties in measuring food and nutrition security, and by refining the research questions addressed in the thesis. Chapter 2 not only lays the theoretical framework which shapes the debate about the impact of food price changes on food and nutrition security from the two

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[2] A full discussion on the advantages and disadvantages of the selected datasets is presented in Chapter 4.

disciplines of economics and nutrition, but it also aims to define the theoretical and methodological shortcomings that the MCES is developed to address.

Chapters 3 and 4 consist of detailed discussions about the two methodological stages through which the thesis unfolds. The first stage looks at the methodology to compute the MCES, and the second is dedicated to the validation of the indicator. Chapter 3 begins by setting the theoretical background at the core of the conceptualization of the MCES and then presents the methodological approach and the data sources used to estimate the indicator. Chapter 4 explains the intents, data and methodology of the *validation process*. The validation stage aims at evaluating the suitability of the MCES as a timely, and easily accessible food price indicator that is sensitive to food and nutrition security alterations. It does so, by assessing the association between the MCES and a set of widely used food and nutrition security indicators at the household level.

Chapters 5 and 6 are dedicated to the empirical analysis that estimates the MCES and analyses its validity using two case-studies: Mozambique (Chapter 5) and Bangladesh (Chapter 6). The two case-studies are intended to represent, on the one hand, two contexts with different agro-climatic conditions, agricultural systems and consumption patterns, and on the other hand, similarities in terms of food and nutrition security status of their population. Both these chapters begin with a brief country profile that introduces country specific poverty levels and food and nutrition security trends. The discussion then focuses on descriptive statistics of food and nutrition security indicators used to assess the MCES validity, followed by the presentation of the results, the discussion and outcome of the robustness checks. Finally, chapter 7 presents the overall conclusions by bringing the key messages and findings of this thesis together and it presents further reflections and indications for future research.

1.3 Terminology

Food and Nutrition Security

This thesis adopts the comprehensive notion of Food and Nutrition Security or Insecurity.Over the years, a large number of conceptual frameworks and definitions of *food security* have been developed in an attempt to explain its causes and its consequences. Recent analyses of food security utilized the definition approved during the 1996 World Food Summit:

Food security exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life. (FAO, 1996).

From this definition four pillars of food security are identified: (i) food availability that addresses the supply of food to a specific population; (ii) social and physical access that concerns the institutional, socio-economical, and environmental burdens that prevent a population from having an adequate food intake, despite sufficient food supply; (iii) utilization of the food (a function of food safety, nutritional status and health (Benson 2014)); and (iv) stability in the manifestation of the above mentioned components.

Nutrition security is defined as the "*situation when all people at all times consume food of sufficient quantity and quality in terms of variety, diversity, nutrient content and safety to meet their dietary needs and food preferences for an active and healthy life, coupled with a sanitary environment, adequate health, education and care."* (FAO 2012). The concept of nutrition security places more emphasis on the dietary quality and, in particular, on the micronutrient deficiencies associated with inadequate intake of vitamins and minerals (Barrett 2010). It is concerned with the nutrition outcome of food intake and it deals with individual health status, caring practices (especially for children), health conditions of the household's environment and, finally, to the state of and access to healthcare services. This research adopts a comprehensive definition of food and nutrition security, as is combines both security concepts in an integrated way as a single goal of public policy and reinforces the circularity between availability of and access to food and nutritional consequences.

Chapter 2 Food price fluctuations, food security and nutrition – a composite literature review

Introduction

The dramatic events in the aftermath of the 2007-2008 food price crisis created a new momentum in the debates about food prices and rekindled the interest of many agencies and practitioners on the impacts of high and fluctuating food prices on food and nutrition security. International development organizations have since positioned food security and agricultural development at the top of their political agendas. Alongside, media channels also dedicated unprecedented attention to the theme of food price crises and their implications in developing countries adding pressure on academia, NGOs and development agencies to better understand food insecurity (Guariso et al. 2014, Swinnen and Squicciarini 2012). Among the most visible outcomes of such reinvigorated interest is the Sustainable Development Goal 2 (SDG2) that aims at ending hunger, achieve food security and improved nutrition and promote sustainable agriculture. Similarly, there have been numerous efforts to mainstream nutrition in most of the interventions promoted by the main UN agency and NGOs that lead international endeavours to end food insecurity (Dufour et al. 2013, Herforth and Dufour 2013).

The crisis unveiled historical discrepancies on what constitutes the 'right' levels of food prices (Swinnen 2010) and accentuated conflicting opinions on the effects of recent food price rises on food and nutrition security (Arndt et al. 2016). Both the 2007-2008, highlighted dissatisfaction with existing indicators and measures of food insecurity and their capacity to gauge and monitor the impacts of shocks on poor populations' food insecurity (Dorward 2013; Skoufias et al. 2013; Headey and Ecker 2012). In spite of a wide recognition of the ethical relevance of food and nutrition insecurity and its socio-economic drawbacks, there is no agreement on appropriate and effective ways to measure this phenomenon, partly due to its complexity (Dorward 2013, Skoufias et al. 2013; Headey and Ecker 2012).

This chapter engages with the contradictions that emerged around the impacts of food prices on poverty and food and nutrition security. Emphasis is placed on the potential impacts of such contradictions on the wellbeing of vulnerable populations in low and middle income countries after the 2007-2008 food price crises. The purpose of this review is to lay the theoretical grounds that inform the conceptualization of the Minimum Calorie Expenditure Share and define the theoretical and methodological weakness that the indicator attempts to address.

Section 2.1 looks at the methodological limitations of the calculation of real food prices and their implications for the analysis of food price impacts on food and nutrition security. Section 2.2 provides a literature review on the impacts of food price increases on food and nutrition security from both an economic and nutritional perspective. Section 2.3 engages with the discussion around the difficulties of measuring food and nutrition security and defines how the MCES can contribute in the methodological advancement. The final section (2.4) states the research questions arising from the literature reviewed in the chapter.

2.1 Food prices: how to get it "real"

The debates on the "adequate" levels of food prices that promote poverty reduction have shifted over the years[1]. As a matter of simplicity, this section broadly puts the debates into two "waves", divided by the 2007-2008 food crises. The period that preceded the 2007-2008 crisis was characterized by the view that low prices were an obstacle to poverty alleviation, especially in rural areas. Low prices for agricultural commodities were considered a threat to food security of "*hundreds of millions of people in some of the world's poorest developing countries where the sale of commodities is often the only source of cash*" (FAO 2005, p. 1). When food prices started their dramatic increase culminating in the 2007-2008 crisis, the view of many leading development and humanitarian organisations altered radically. In a short period of time the dominant theme in the literature had switched to emphasising the negative effects of high food prices on food security and poverty on the world's poor (Swinnen 2010).
However, this is not to suggest the crisis brought about a consensus in the development community. A number of analytical reports gave contradictory interpretations of the effects of the crises on the wellbeing of poor people in low and middle income countries. One line of argument, that places the 2007-2008 prices in a historical context, claimed that, despite the severity of the 2007/08 price spike, real-terms cereal prices in 2008 were substantially lower than cereal prices during the mid-70s food crisis (von Braun 2008; FAO, IFAD, and WFP 2008; Piesse and Thirtle 2009, Godfray et al. 2010). Similarly, FAO (2009) stated that, when the 2000

[1]In his 2010 paper on The right price of food, Swinnen questions the narrative around high or low food prices that are, at times, beneficial or harmful for poor population. These narratives tend to be shaped according to the policy messages that NGOs and international organizations are seeking to deliver and raises questions on the impacts of communication (both from mass media and from influential organization) on the process of policy making, welfare and development (Swinnen 2010).

prices and exchange rates are taken into account, "*the cost of one tonne of rice in 1974 stood at well over four times the average over the first four months of 2008*" (p. 121). By taking a longer term view, other studies have highlighted that real (international) wheat prices at their peak in 2008 were significantly lower than those recorded in the period preceding the 1960s and "*not particularly high*" in historical terms (Von Braun, 2008, p. 3). Interpretative discrepancies that, on the one hand, acknowledge the severity of the food crisis that took place in the 2000s and, on the other hand, state the "perception" of historically low real grains prices, suggests there could be methodological shortcomings in how real food prices are calculated and how the impacts of real food prices on poor populations are analysed (Dorward 2011). Although staple food prices represent an easily accessible data source[2], they can lead to misleading interpretations when used for judgements on food and nutrition security.

When measuring the repercussions of food price fluctuations on the wellbeing of poor populations, it is important to understand the extent to which they experience food price changes and how far these changes are offset by economic growth and income distribution. The following section critiques the methodologies for calculating real (food) prices in ways that can lead to ambiguous interpretations in terms of welfare and food security. It is predominantly based on an article by Andrew Dorward (2011) that explored the incongruities in interpreting the impacts of the 2008-2009 food crisis on the poor and that had set the ground to the future elaboration and development of the Minimum Calorie Expenditure Share.

2.1.1 Real prices and the use of Consumer Price Index

Dorward (2011) suggests that the perception of historically low real food prices is an *artefact* deriving from the extensive use of the Consumer Price Index (CPI), and similar indices[3], as the deflator to obtain real prices. He also argues that such real prices provide flawed information about what poor consumers experience when they are exposed to high food prices. This is

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[2]The availability and accessibility of price data, especially on basic food commodities (cereals but also roots and tubers, although to a smaller extent) have increased and datasets such as the FAO Food Price Monitoring and Analysis Tool represent valuable data sources. Detailed description of this dataset is presented in Chapter 6.

[3] For example, the FAO Food Price Index uses the Manufacturers Unit Value (MUV). The MUV is a composite index of prices for manufactured exports from the fifteen major developed and emerging economies to low– and middle– income economies," and, therefore, may be considered a "proxy" representing the rate of exchange between agricultural commodities and manufactured products, especially relevant for developing countries. It should be noted that the "FAO Food Price Index is a measure of the monthly change in international prices of a basket of food commodities", developed to monitor agricultural market trends and not to measure a food and nutrition security. (http://www.fao.org/worldfoodsituation/foodpricesindex/en/, accessed on 20 July 2017). However, since the 2007-2008 food crisis the FAO Food Price Index received unprecedented attention from the media and represented the symbol of the food crisis and its effect on poor populations.

because the construction of real prices does not take account of the expenditure patterns of poor people, and overlooks the different effects that economic growth may have on the consumption patterns of poor and rich consumers (Dorward 2011; 2013). The remainder of this section is dedicated to the explanation of these two concepts.

The use of real prices, rather than nominal prices, stems from the fact that most economies are affected by inflation that erodes the value of money and precludes year-to-year comparisons. Annual inflation is calculated in terms of average yearly increase in prices of a representative basket of all goods and services produced by the economy, termed Consumer Price Index (CPI):

Equation 2.1

$$\mathrm{I_t} = \mathrm{CPI_t}/\mathrm{CPI_{t-1}}$$

where $\mathrm{I_t}$ denotes the inflation rate at time *t* and $\mathrm{CPI_t}$ and $\mathrm{CPI_{t-1}}$ denote the Consumer Price Index at time *t* and *t-1.*

In turn, the CPI is calculated as follows:

Equation 2.2

$$CPI_t = \sum(P_{jt}w_{j0}) / \sum(P_{j0}w_{j0})$$

Where $P_{jt}$is the nominal price of good or service *j* at year*t* and $\mathrm{w_{j0}}$ represents the expenditure share on good or service j in the base year t=0 of a representative consumer's expenditure basket. The formal specification of the weighting system is:

Equation2.3

$$w_{j0} = P_{j0}Q_{j0}/\sum_{j=1}^{n} P_{j0}Q_{j0}$$

With Q_{j0} being the quantity of good or service *j* purchased in the base year *t*=0 at price P_{j0}, and $\sum_{j=1}^{n} P_{j0}Q_{j0}$ representing total consumer expenditure in the base year (*t*=0) on goods and services *j*=1 to *n*.

Finally, real prices of good or service *j* at time *t* in constant prices for *t*=0 is calculated as

Equation2.4

$$\boldsymbol{P}_{jt} = P_{jt}/CPI_t$$

Before starting considering element by element why estimates of real prices relative to CPI can be inappropriate for food and nutrition security analysis, Dorward (*Ibid.*) sets two simple recognitions. The first states that any change in relative prices of food and services that are purchased are generated by the changes in the supply and demand balance of the said goods and services. The second states that demand and supply of good and services can be affected by shocks and short term alterations as well as long term trends influencing, in the supply side, production costs and on the demand side, consumers purchasing power and preferences. In Dorward's (2011) view, over time, economic growth that increases productivity, will contribute to increased demand thanks to income increases and supply boost lead by reductions of production costs. However, supply and demand changes will be different for different goods and services, depending on the speed at which increases in productivity occur, incomes grow and changes of income elasticity of demand for what the economy produces (*Ibid.*).

In his article, Dorward's (2011) view is exemplified by stating that although Equation2.4 is "[…] *widely used to calculate 'real prices', but the real price is more accurately described as the ratio of price for particular goods and services to the prices of other goods and services, or 'real price relative to CPI'*. (*Ibid.:* 4). A number of issues derives from this formulation of real prices when the implication of food price fluctuations on welfare are analysed. Firstly, real prices are inappropriate to take into account the changes of food and non-food consumption expenditure due to changes in incomes both within and between countries. Secondly, Dorward (2011) notes that differences in expenditure shares among different groups affect the value of real prices and, in turn, hamper the reliability of the interpretation of real food prices in terms of food and nutrition security. The remainder of this section will unfold these two concepts.

As a matter of simplicity, the analysis considers a relatively poor and closed economy that produces and consumes food and non-food goods. In this simplified scenario, the category of "food" goods represent a significant share of consumption expenditure with low price and low income elasticities of demand. On the other hand "non-food" goods account for a limited share of consumer expenditure with higher price and higher income elasticities of demand. Therefore the following relationships emerge:

1) Changes in peoples' income and economic position will modify the composition of non-food and food expenditure[4];

[4] Such modification can occur within each group and between the food and non-food group, in terms of their respective share in the aggregate demand.

2) Increasing (decreasing) incomes tend to expand (reduce) the share of non-food goods and lower (generally unalter) the expenditure share of food goods;
3) Increasing people's incomes or a country's economic growth, over time, tend to decrease the relative price of goods and services with higher income and price elasticises.

Based on these relationships the following emerges: first, people with different income levels will have different expenditure basket composition, and second, food will be mostly important for poorer people while the opposite will be true for the better-off segments of the population. Empirically, poorer consumers spend a large share of their income in purchasing food, and in poorer region of the world, this share can reach 50 to 80% of their total expenditure (Brinkman et al. 2010). Poor consumers cannot buffer food price shocks by switching from expensive to cheaper food when prices increase, since their purchases already include mostly the cheapest foods available prior to the shock. Because CPIs consider a single expenditure basket, they create analytical flaws in terms of impacts of price changes on poorer population. They are unable to capture the different importance of food in the "CPI" for poorer people (and countries), and they do not account for the different composition of non-food expenditure between rich and more vulnerable consumers (and economies).

Dorward (2011) continues by identifying two *distorting* effects generated by the difference in expenditure shares. The first, d*enominator effect,* depicts the dampening effect on the real price of any commodity included in the CPI. For example, the real price of commodity A at time *t* is calculated by deflating the nominal price of commodity A against the reference CPI.

Equation 2.5

$$\boldsymbol{P}_{At} = P_{At}/CPI_t$$

However, the CPI is a basket of goods and services that also includes the price of commodity A. Because there are changes of the same value both in the denominator and in the numerator the value of real prices is dampened. Ideally, it would be more accurate to divide the nominal price by a CPI that omits the commodity for which the real price is calculated (Dawe et al. 2015). When the nominal price of a commodity increases, the use of the aggregate CPI in calculating the real price tends to understate the *real* magnitude of the price increment relative to other commodities. The denominator effects will be greater if the percentage of commodity A is relatively higher compared to other commodities (both goods and services) included in the computation of the CPI. Food and especially cereals tend to have a significant share in the CPI of poorer countries.

The *non-food basket effect*, is the second effect mentioned by Dorward (2011) and is linked to the use of rich countries' CPI to obtain real prices. This is the case for most international real food prices calculated using the CPI relative to the United States (US CPI) which are used to interpret and analyse the welfare effects of real food price fluctuations globally. In general, the expenditure baskets for groups and countries with higher incomes change more than for groups with stagnant or lower incomes. This is not only with regards to the greater importance of non-food expenditure in their income, but also in the nature of the non-food expenditure. Whilst higher income groups have higher expenditure shares for non-food goods than for food goods, prices for the non-food items they buy tend to rise relative to food prices. Conversely, food prices dominate the CPI calculation for low income groups and prices of non-food expenditure, which makes up a much smaller proportion of their basket, tend to be lower.
Again, a stylized scenario is used for a clearer explanation. Consider two countries X and Y, where X represents the low income countries and Y the higher income one. Goods that are consumed are distinguished between Food (F) and Non-Food (NF) items. Therefore, the CPI relative to the two setting will differ in the following characteristics:

Equation 2.6

$$CPI_{Xt} = \sum (P_{XFt} w_{XF0} + P_{XNFt} w_{XNF0}) \,/\, \sum (P_{XF0} w_{XF0} + P_{XNF0} w_{XNF0})$$

$$CPI_{Yt} = \sum (P_{YFt} w_{YF0} + P_{YNFt} w_{YNF0}) \,/\, \sum (P_{YF0} w_{YF0} + P_{YNF0} w_{YNF0})$$

where P_{XFt} and P_{YFt} refer to the prices of food items in country X and Y, $P_{XNFt}$and P_{YNFt}refer to the prices of non-food goods in countries X and Y and w refer to the weights assigned to each group of items in each of the two countries. As noted and illustrated in **Error! Reference source not found.**, the non-food basket effect originates from the fact that both the share of expenditure and prices of non-food items are higher in high income economies making the non-food component prevail on the food component.

Relationship 2.1

$w_{YNF0} > w_{XNF0}$ and $P_{YNFt} > P_{XNFt}$

Combined, these two effects lead to CPIs with higher values for contexts that are relatively richer.

Relationship 2.2

$$CPI_{Yt} > CPI_{Xt}$$

When CPI_{Yt} is used to adjust nominal prices for inflation in country X, this causes “artificially” lower values of real prices (relative to the US CPI). Similarly, US CPI and similar deflators, based on the expenditure bundle of rich and growing economies, will lead to the computation of real price estimates that inadequately reflect the “real” impact of food price changes on poor population in low-income countries. In particular poorer consumers will not have experienced the same falls in real food prices as those with growing incomes and are more vulnerable to price shocks.

When analysing the impact of food changes on low income groups, the use of real prices calculated with US CPI is misleading because it artificially dampens the level of price increase experienced by low income people and countries. Considerations on the historically low food price levels presented in publications cited earlier in the chapter, emerge from the decontextualized use of the US CPI to calculate international real prices. Similar indices and tools incorporate economic growth (and the modifications in consumption patterns that is generated) of high income countries and growing economies, in contexts that have not experienced the same growth, or on the contrary have undergone years of economic stagnation.

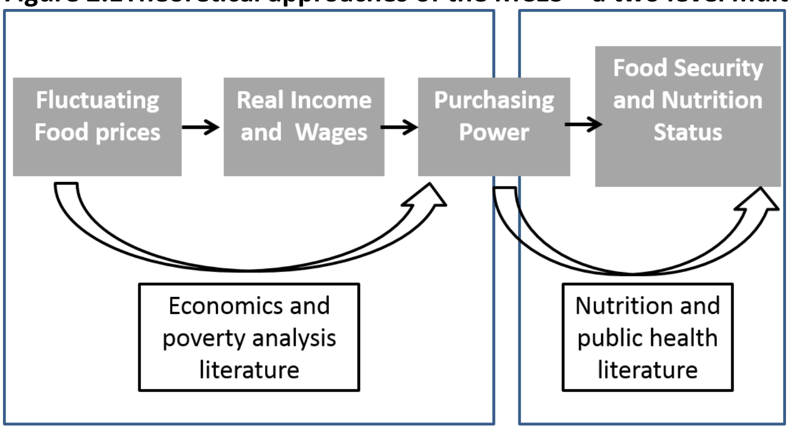
The methodological questions highlighted so far can produce interpretative complications with reference to the implications of (real) food price changes on food and nutrition security analysis. Yet, ad hoc CPIs calculated for lower income groups or food CPIs can be of little help in measuring the effects of fluctuating food prices on nutritional status of poor people. The main problem is that real prices do not capture the effects that changing prices produce on purchasing power, as the construct of real prices is as such that compares the increase of prices of good A against a basket of other goods and services. Because food accounts for a significant share of poor people’s expenditure, increases of food prices lead to a reduction of disposable income, hindering the ability to continue to purchase food and/or reducing the residual income available for non-food purchases (Dorward 2011; Dorward 2013). To better capture the “income effect” of food price changes, Dorward (2011, 2013) suggests that for such category of poor consumers, food prices should be compared to income as it can provide a more refined indicator of how different (and particularly poor) consumers are affected by changing food prices.

As it will be thoroughly discussed in Chapter 3, the methodological strength of the Minimum Calorie Expenditure Share developed and examined (against other food and nutrition security measures) is represented by the inclusion of the *income effect* for different expenditure groups.

2.2 Fluctuating and high food prices and their impacts on food and nutrition security – a literature review

The following section further elaborates on the relationship between food prices and income and how the effects on purchasing power can translate on food and nutrition security. The theoretical approaches at the core of the MCES are two fold (graphically illustrated inFigure 2.1). The thesis considers two levels of analysis: one that looks at the effects of food price fluctuations on real incomes, wages and purchasing power (left block of Figure 2.1), and the other that links purchasing power variations to repercussions on nutritional status (right block of Figure 2.1).

Figure 2.1Theoretical approaches of the MCES – a two level multidisciplinary analysis



Source: Author

Following this analytical approach, section 2.2 provides a composite literature review on the impacts of food prices on food and nutrition security in two stages. It first draws from the economics and poverty analysis literature on the impacts of food prices on household poverty, welfare and food security (Section 2.2.1), and then follows by reviewing the literature pertinent to public health and nutrition scholarship that analyses the impacts of food prices on nutrition status of poor population in low and middle income countries (2.2.2). Distinguishing the effects of food price changes on food and nutrition security in two stages is a stylized depiction to help emphasizing the individual elements at the core of the MCES theoretical approach.

2.2.1 (Food) Price increases, income and welfare: Literature review and evidence

In the field of empirical economics, studies that look at the effects of food prices on welfare and poverty are usually distinguished, on the one hand, between those that analyse how people have experienced food price variations on their livelihoods and welfare, and on the other hand, simulations that reproduce such effects (Dorward 2012).

Prior to the 2007/09 food price crisis, a large number of studies on impacts of high food prices on welfare and poverty addressed issues of inflationary policies, trade reforms and financial crisis (Ravallion and Datt 2002, Easterly and Fisher 2001, Romer and Romer 1998). Results from such analyses agreed that increases in inflation can have uneven distributional effects, with the welfare cost being significantly higher for low-income groups than for their higher income counterparts (Erosa and Ventura 2002). These costs generally manifest in terms of income erosion and decrease of wage rates. For example, Easterly and Fisher (2002) highlight that inflation makes poor populations (in particular unskilled workers and/or those with low levels of education) worse off because higher prices tend to lower their real income as well as their real wages. Similarly, Ravallion and Datt (2002) suggest that in the short-term the poor will suffer from adverse effects of inflation via the negative effect on real wages, especially of unskilled labour. If inflation affects food prices, this will further aggravate the negative effects on the poor as they devote a large share of their income to food purchases.

Others have analysed the relationship between food prices and welfare by gathering evidence from studies that examine the drivers of poverty reduction via improvement of agricultural productivity.Among various pathways that generate positive outcomes, the *food price pathway* (De Janvry and Sadoulet 2010) suggests that increased and more efficient agricultural productivity will reduce domestic prices of consumption goods while creating marketing opportunities for net-sellers. Lower food prices can support real income of urban poor, landless rural workers and net-buyers among small holders, without hampering net-sellers livelihoods. According to Irz and Roe (2000) lower food prices, via improvements of agricultural productivity, can generate an increase in (poorer) household saving rates providing an exit channel from poverty. This is in line with other studies that emphasize the importance of food purchase on income of poorer households. As the share of income devoted to food purchase is typically higher for poorer households, lower food prices can have a significant positive impact on their welfare (Thirtle et al. 2001).

After the global food price increases in 2008-2009, various efforts were made to consider the implications of the global food crisis for the welfare of households, regions, and countries. In their cross-sectional analysis on the implications of the food price crisis at the household level, Ivanic and Martin (2008) found that the crisis resulted in heterogeneous impacts. Effects of food price increases and their volatility are likely to be different between and within different countries depending on macroeconomic conditions, the role played by countries in international trade, structure of the food system and the nature of the price increase (Ivanic and Martin 2008). A useful starting point in determining such impacts is represented by the analysis of the net-food buyer or net-food seller position of low income household[5] (Deaton 1989, Aksoy and Isik-Dikmelik 2007, Ivanic and Martin 2008). In their conclusion they state that, across the countries considered in the study[6], the widespread negative impacts on net buyers offsets the gains to net sellers and ultimately resulting in widening poverty.

The importance of household's net-food buyer or net-food seller position when looking at the effects of food price fluctuations is also highlighted by Dercon et al. (2012) in their study on 1500 rural Ethiopian households. Between 2004 and 2009 poverty rates rose by 17% points a trend that they attribute, on one hand, to bad a harvesting season combined with the net buyer position of most surveyed households, and on the other, significant increases of both global and local food prices that exacerbated the pressure on food prices after the crop loos. Using a general equilibrium model, Arndt et al. (2008) assesses the impact of higher fuel and food prices at both household and macroeconomic levels in Mozambique during the 2008-09 price crises. Results indicate that the fuel price shock dominates rising food prices from both macroeconomic and poverty perspectives, with increases in poverty particularly severe in urban areas. More recently, in their paper Minot and Dewina (2013), explore the distributional impact of higher maize, rice, and other food prices in Ghana between 2007-2008 and find that, while higher maize and rice prices have a relatively modest short-term impact on national

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[5] Following the definition by FAO et al (2011), net food sellers are households for whom total sales of food to the market exceed total purchases of food from the market. On the other hand, for net food buyers the total purchase of food is greater than the total sales of food on the market. Generally, net food consumers (such as, for example, urban dwellers and poor landless rural households) tend to be negatively affected by higher food prices, while net food producers can benefit from such opportunity to sell their products at a higher market value. As it will be explained in later parts of the thesis, the translation of high food prices to increased income of net-food sellers faces numerous challenges especially in the context of low-middle income countries.

[6] Ten countries were included in the study: Bolivia, Cambodia, Madagascar, Malawi, Nicaragua, Pakistan, Peru, Vietnam, and Zambia. Poverty was calculated as standard the "dollar-a-day" from the 2007 World Bank World Development Indicators (WDI) (Ivanic and Martin 2008).

poverty, they have significant negative effects on specific groups of households. According to expectations, urban households are adversely affected by such rises of grain prices, but also large percentages of rural households are severely impacted due to their net-food buyer position.

De Hoyos and Medvedev (2011) provide a formal assessment of the implications of higher prices for global poverty (taking into account 73 low income countries) over the period of January 2005 and December 2007. Although they find that the implied increase in the extreme poverty headcount at the global level is 1.7% (which is considered by the authors relatively low), they also appreciate that the global number obscures a significant amount of regional variation. If on the one hand, poverty head count ratios remained relatively unchanged in Eastern European, Central Asian and Latin American countries, on the other hand the headcount ratios in East Asia and in the MENA[7] region increases by approximately 6% and 2.4% respectively.

A number of studies looked at the impact of the food price crisis with an urban-rural lens. Focusing on the effects of the 2007-2008 food crisis, analysis by Robles and Torero (2010) (that examines four Latin American countries) and Wodon and Zaman (2009) (twelve countries in Sub-Saharan Africa) foreseeably conclude that national poverty rates increase, with urban areas (where net-food buyers are more prevalent), on average, suffering larger increases. Despite the fact that the majority of urban dwellers are net food consumers, not all rural households are net food producers (Timmer 1991). In the context of low income countries, farmers with little land and rural households that rely on agricultural labour (that can ether have land or be landless) are often net food buyers, as they do not own land or enough land to produce all the food they consume. It has been demonstrated that some of rural labourers that work on farms can be paid in kind (typically in food). However the quantities that they receive are seldom enough to sell the surplus on the market (Gulati and Dutta, 2010). They tend to heavily rely on food markets and, therefore are likely to benefit from lower prices.

On the other hand, high food prices can represent an incentive to boost agricultural productivity offering opportunities to increase labour demand, rural wages and therefore reducing poverty in the long-term. It is claimed that even if the bulk of people residing in rural areas are net food consumers, their engagement in farming provides them with scope to adjust production in response to higher food prices (Hertel et al. 2004, Headey and Fan 2008,

[7] MENA: Middle East and North Africa.

2010). According to this strand of more recent literature, considerable boost in agricultural production and wage adjustment after increases of food prices can reduce net poverty because most of the poor reside in rural areas that will ultimately benefit from increased productivity (Headey and Hoddinott 2016). Using a general equilibrium model, Jacoby (2016) demonstrates that if the agricultural sector is large, the agricultural supply response can generate increased demand for unskilled labour. The demand for unskilled labour is accommodated by transferring labour from the manufacturing and service sectors via the adjustment of agricultural wages that will be high enough to shift labour to agriculture from other sectors. Finally, as Aksoy and Isik-Dikmelik (2008) mention, high food prices can have potential redistributive effects. They argue that on average incomes of net food buyers (especially those residing in urban areas) tend to be larger than incomes of net food sellers, and therefore high food prices would transfer income from higher income groups to those with lower income.

Using the Afrobarometer[8] data Verpoorten and colleagues (2012) apply self-reported food insecurity information to analyse the effects of the 2007-2008 food price crisis on food insecurity[9]. Their results suggest that effects of food price increases on self-reported household food security are heterogeneous and consistent with assumptions regarding household and country position in terms of net food consumption and economic growth. Specifically, at the micro level, they find that self-reported food security improved for rural households, while it worsened for households in urban areas. At the macro level, the study reports improvements in food security occurred for food exporting countries that could benefit from higher international food prices. In a review, Headey (2011) analyses self-reported food insecurity from the Gallup World Poll (GWP), a survey that covers almost 90% of the developing world population over the period 2005-2010. Findings suggest that although there was large variation across countries, global self-reported food insecurity fell sharply from 2005 to 2008, despite the peak of the food crisis in the same period, with estimates ranging from 60 to 340 million people (*Ibid.*).

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[8] Afrobarometer is a research project funded by the Institute for Democracy in South Africa, the Ghana Centre for Democratic Development and the Department of Political Science at the Michigan State University and it seeks to explore public attitudes towards governance and socio-economic scenarios.

[9] Afrobarometer surveys' question relative to food insecurity is formulated as follows: "Over the past year, how often, if ever, have you or anyone in your family gone without enough food to eat?" Verpoorten and colleagues (2008) categorised the responses as: 1=Never, 2=Just once or twice, 3=Several times, 4=Many times and 5=Always.

This brief discussion on the studies that look at the impacts of food price changes on welfare, poverty and food security depicts a heterogeneous scenario of findings. There are stark differences between countries in terms of economic structures and growth levels. With the recognition that impacts of high and volatile food prices on poorer segment of the population (regardless to their position in the production-consumption spectrum) are detrimental in terms of poverty and food security, this thesis attempts to contribute to this discussion. The majority of these studies have not investigated the different impacts that food price increases can generate on different income groups and often they have not specified the extent of the short-term costs of food price volatility on the welfare of vulnerable groups.

2.2.2 High and fluctuating food price and consequences on nutritional status.

Studies that examine the nutritional impact of food price increases (and in general of economic crisis) provide additional support to the notion that high and fluctuating food prices hurt the poor in complex ways that go beyond than pushing them below the poverty line (García-Germán et al. 2013, Martin-Prével et al. 2000). In particular, the implications of the 2008 food and fuel price crisis on nutrition status are yet to be fully understood and are a primary concern especially when it concerns child undernutrition (Lock et al. 2009; Keats and Wiggins 2010; Tiwari and Zaman 2010; Ruel et al. 2010; Christian 2010; Brinkman et al. 2010, Arndt et al. 2016). The following section looks at the literature and evidence on the multiple manifestation of nutrition insecurity caused by food price shocks and economic crises. While the focus of this section is primarily on the 2008-2009 crisis, there will be some references to studies that cover similar issues in preceding periods. This section is organized in a way to consider different measurement of nutrition security (such as dietary diversity and anthropometric measurements) that will be used as comparator measures to assess the "validity" of the MCES (Chapters 5 and 6).

Food prices shocks and financial crises have emphasized the precarious wellbeing amongst the poor and the most vulnerable. There is a growing recognition that food price crises, combined with increased demand for food commodities, pressures on the environment and climate change, interact synergistically causing failures over different segments of the food systems with catastrophic effects on livelihoods and long lasting impacts in terms of inequality in the access and availability of food and health (Bloem et al. 2010). Most of the studies suggest that the relationship between food price increases and nutritional deterioration is heterogeneous, depending on the commodity affected by the price surge, on its demand elasticity and contextual characteristics that determine patterns of food consumption and preferences[10]. Studies that have looked at energy intakes during food price rises argue that the consumption of calorie is less affected than consumption of other nutrients. In a study on nutritional impacts in El Salvador, De Brauw (2011) finds that albeit child[11] height-for-age z-scores (a commonly used indicator of chronic undernutrition) declined[12], weight-for-age z-score (a measure of acute undernutrition) did not experience similar deterioration. This result can imply that children were consuming less key nutrients in order to maintain energy intakes. Similarly, D'Souza and Jolliffe (2010, 2013a, 2013b) estimates on Afghanistan, indicate that among most vulnerable households, which are unable to afford substantial cuts to calories, there was little decline in energy intakesafter the wheat flour price increases in 2008. Conversely, households with high-calorie diets experienced large declines of energy intake. They also suggest that the behavioural responses of households and how food insecurity is manifested varies across the distribution of the food security measure of interest (*Ibid.*). For example, households at the bottom of the household dietary diversity distribution (using the Food Consumption Score[13]), experienced the largest declines in dietary diversity as a result of food price increases in order to maintain adequate levels of calorie intakes.

The effect of staple food price increases on consumption are dependent on context specific elasticity of demand for this produce. The impacts of fluctuating food prices on consumption are epitomized in price elasticities, expressed by the relation between the demand for a specific food item and its own price (own price elasticity of demand) or with other food and non-food item (cross price elasticity of demand). Elasticities describe the percentage of food quantity that is demanded in response to 1% increment of its price. Own price elasticities are usually negative while its magnitude varies depending on the availability of substitute foods, its importance in the diet, the proportion of consumption budget spent on food and seasonality. The interpretation of these coefficients relies on the importance of the food item

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[10] Although this work recognizes the centrality of determinants of food consumption and preferences (such as Nutrition Transition (Popkin 1998, 2003), urbanization, agricultural commercialization, trade, food systems and food norms), it mainly focuses on issues related to food prices, income, purchasing power and food and nutrition security.

[11] De Brauw (2011) referres to child under three years only.

[12] De Brauwn (2011) indicates that such declining effects were mitigated for families with access to remittances from relatives and therefore, had more disposable income to purchase nutritious food.

[13]The Food consumption Score (FCS) is a measure used by the World Food Programme (WFP) that proxies diversity and frequency of food consumed within a 7-d recall period at the household level. Higher scores indicate better diets and more food security at the household level. More details on this indicator will be presented in later chapters, as the FCS is one of the comparator measures used in the micro-validation of the MCES.

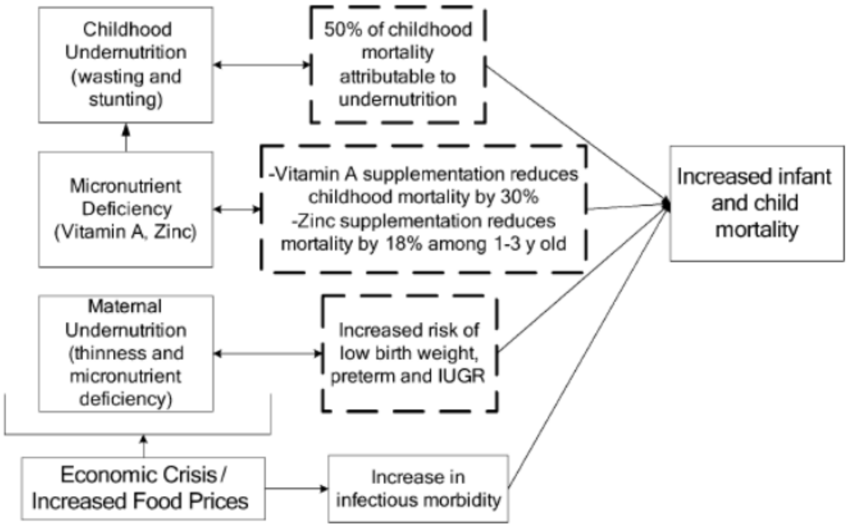
on diets and income levels. On the one hand, high price elasticities indicate that the consumption of a specific food item is very sensitive to price increases (for example confectionery products). Conversely, small elasticities denote that the good is a necessity in the diet (staple foods such as cereals) and there is a tendency for people to spend more on such foods when prices increase.If elasticity of demand for staple is high, price increases lead to lower consumption the food item. This is what happened, for example, in parts of China after a surge of rice and wheat prices that increased consumption of pulses, a substitute food that ultimately provided more nutrients (Jensen and Miller 2008). Conversely, when demand is inelastic, higher food prices will leave consumed quantities mostly unchanged. Raihan (2009) study on the effects of the 2008 price crisis in Bangladesh, found that while 25% of households reduced their rice consumption, over 70% of households in Bangladesh maintained their consumption levels to the pre-crisis period and 7.5% increased their rice consumption. Reductions of mean consumption of dietary energy and deterioration of the distribution of food calories are also revealed by Anríquez et al. (2013) in a cross-country analysis (that uses a partial equilibrium approach to detect nutritional and welfare impacts of staple food price increases).

The nature of substitutes, the type of diets and foods consumed are critical for assessing the nutritional consequences of high food prices (Brinkman et al. 2010). Using own food price elasticities to quantify the change in demand for foods in response to changes in food prices, Green et al. (2013) find that in low income countries (and in lower income households within these countries) the relationship between food prices and demand for food is stronger compared to high income countries (and higher income households within countries). These results suggest that food price increases will tend to have disproportionately larger impacts on low income countries as well as more vulnerable segment of the population. Findings also suggest that, regardless of the country's economic position, elasticities of animal source foods (ASFs) where higher than those of dietary staples (cereals, fats and oil) – an indication of the fact that ASFs represent luxury goods (and therefore are the first ones that witness reductions when prices increase) while consumption of staples is reduced with difficulty.

When economic crisis and food price increases exacerbate and/or are not meet with mitigating interventions, child mortality can increase via a number of nutritional pathways. Christian (2010) explores the pathways through which price increases and economic crisis can exacerbate child mortality. Such pathways are illustrated in

Figure **2.2**.

Figure 2.2 Child Mortality and food price crisis: an illustration of nutritional pathways



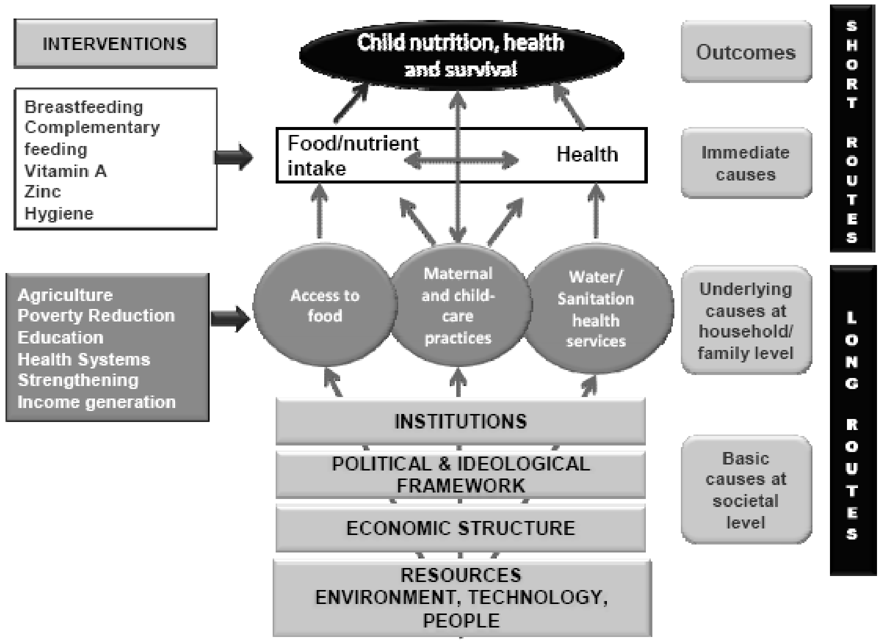
Source: Christian 2010

When faced with decreased access to and availability of food, vulnerable children can be exposed to acute and chronic undernutrition, and other nutritional deficiencies that interact with infectious diseases, increasing risks of child mortality (*Ibid.*). Using casual evidences from randomized controlled trial studies, the author suggest that wasting and stunting, deficiencies of vitamin A and Zinc (associated with higher risks of diarreha, pneumonia and stunting) and factors related to maternal nutrition, are among the most detrimental nutritional factors that affect child mortality. Infectious diseases tend to deteriorate during crises, due to worsening of clean water supply, sanitation and higher exposure to disease vectors (*Ibid.*).

A number of studies look at the nutritional pathways of economic crises and sharp food price increases and their consequences on child and maternal undernutrition. Vellakkal et al. (2015)investigated the associations between food price spikes and childhood malnutrition in Andhra Pradesh in 2008-2009, one of India's largest states, using wasting as the indicator of recent and severe process of weight loss that can result from acute food shortage. Concurring withescalating food prices, prevalence of wasting increased significantly to 28% in 2009 (compared to 19.4% and 18.8% in 2002 and 2006 respectively). In addition, the distribution of such increase was uneven, with increases concentrated among low- and middle- income groups, and virtually absent among high-income groups. During raises of maize prices that resulted from the southern African drought of 2001–2002, Zambia experienced maternal health deterioration (measured in terms of significant decreases of maternal plasma vitamin A during pregnancy and vitamin E deficiencies postpartum) and infant length of specific age groups decreased progressively throughout the study carried out by Gitau et al. (2005)[14].

Although food intake is one of the immediate causes of undernutrition, other factors such as related to health and care play a main role. The conceptual framework of the determinants of undernutrition, developed by UNICEF (1990) (Figure 2.3), emphasizes such distinction and provides a holistic definition to nutrition security that includes food intake together to access to health services, water, sanitation and adequate child and maternal care.

Figure 2.3 UNICEF conceptual framework on child nutrition, health and survival



Source: Ruel 2008: 22, Adapted from UNICEF 1990

The framework acknowledges that multiple factors interact synergistically to determine nutritional status and therefore distinguishes between different levels of causes: basic, underlying and immediate. Basic causes are referred to factors linked to political, institutional, socio-economic and environmental issues. Underlying causes reduce the focus on issues directly linked to food security (as in access to food), maternal and child care practices and the

[14] Data on maternal and infant health, nutrition and maternal plasma were collected and subsequently analysed according to whether they were collected before (June to December 2001), during (January 2002 to April 2003) or after (May 2003 to January 2004) the period of increased maize price. Agricultural season and maternal HIV status were used as controlvariables in the analyses (Gitau et al. 2005).

health, sanitary and water environment within a certain area and in the household. Finally, in the immediate causes the interaction between nutritional deterioration and health is highlighted[15]. Both underlying determinants can be affected by price increases. When purchasing power decreases, households may have to undertake difficult decisions in order to release more available income for food, such as reduce quality and quantity of purchased food while poorer households may cut on health care or withdraw their children from school (Klotz et al 2008).

These contributions show that the effects of food price fluctuations on nutrition status are concerning but manifest in complex and multifaceted ways. Deterioration of food access (both in quality and quantity) together with worsening access and availability to health, care services and healthy environment during food price crisis can generate life-lasting effects in terms of micro and macronutrient-deficiency-induced child morbidity and mortality degenerative effects on vulnerable adults. While looking at food prices can be useful and can signal early deterioration of food access, food prices alone can lead to misleading interpretations and fail to represent the indirect effects that they can produce on nutritional status of the most vulnerable.

2.3 Food and Nutrition Security: measurement difficulties and how the MCES can contribute to the methodological improvement

The complex interactions between different aspects that shape food and nutrition security, make this concept *elusive* (Barrett 2010). The concept of food and nutrition security highlights the multidimensional nature of the phenomenon and analysts often face the difficult task in choosing the most adequate and relevant (set of) indicator(s) or proxies to measure different dimensions of food and nutrition security (de Haen et al. 2011). This choice embroils inevitably a compromise between comprehensiveness of the indicator (which can be labour intensive and associated with higher costs) and containment of costs and ease to generate estimates. Each metric can encompass or disregard certain factors that shape the deterioration of food and nutrition security.

[15]The framework's version reported in this thesis identifies a number of measures to reduce maternal and child under-nutrition in the short-term as well as recognizing that they should be coupled with more long-term interventions designed to the improvement of political, institutional, socio-economic and environmental issues. (UNICEF 1990)

The scholarship that focuses on these themes and policy practices witnesses no shortage of food and nutrition security indicators. Such proliferation emphasizes, on one side, the general recognition of the relevance of food and nutrition security, but, on the other, stresses the lack of agreement between agencies and practitioners on an effective and affordable common approach for its measurement (de Haen et al. 2011). Some argue that the absence of widely accepted reliable and timely measurement can hamper the capacity to recognize and act responsively to crisis and chronic food and nutrition security shocks (Headey and Ecker 2012). It is also considered that such limitations in measuring food and nutrition security restrict the ability to thoroughly understand this concept, its drivers and design appropriate interventions. This, in turn, holds back the improvement of programme design and implementation to reduce food and nutrition insecurity.

There is however a general trade-off between comprehensiveness and accuracy on the one hand (requiring data intensive household surveys) and the need for easier, more frequent and lower cost data collection on the other. Practitioners, researches and international agencies face the challenge to identify indicators that meet a range of desirable properties, are straightforward to compute and provide clear, timely and unbiased signals on the nature and extent of food insecurity problems in different populations and, ideally, some information on types of intervention that can address these problems. In this context, a timely metric to gauge the importance and effects of shocks that undermine food security cannot rely on time consuming and laborious data collection. There is, therefore, the need to identify alternative signals that represent the desirable balance between cost-time efficiency, comprehensiveness and accuracy (Dorward 2013; Skoufias et al. 2013, Headey and Ecker 2012).

This thesis recognizes these tensions and introduces the MCES, a novel food price indicators to describe the effects of food price changes on food and nutrition security. The MCES positions itself in such debate as a useful, timely and effective food price indicator that is relevant to food and nutrition security analysis and can be a viable alternative to real food prices. In the context of food price shocks (or shocks that has immediate implications in terms of food prices), the MCES is conceived to offer a timely signal and initial indication of the depth of the food price fluctuation impacts on food and nutrition security in the short-run. The initial stage should be followed by analyses that use a suit of relevant and context specific indicators that provide additional information in terms of specific consequences of the price shock. In an effort to provide a pragmatic methodological contribution to the measurement of the impacts of food price variations on food and nutrition security, the following guiding criteria are identified:

- Reproducibility: the results can be replicated by anyone at any time, since all the necessary resources and methodology are transparently and accurately provided and explained.
- Simplicity: the information should be accessible to wide range of audience (domestic policy-makers, media and civil society).
- Achievability and cost-effectiveness*:* the indicator should use attainable methods and underlying data that can be realistically gathered within reasonable costs.
- Timeliness and intertemporality: data and methods are easily retraceable and the methodology allows for timely responses. In the context of food security and agriculture, the inter-temporal criterion emphasizes temporal comparisons on two levels: firstly, the ability to measure the effects of seasonality on food and nutrition security; secondly, consider the outcomes of significant short run shocks.

Additionally, the MCES aims at drawing (back) further attention to the role of agricultural seasonality on food and nutrition security. High food prices are often analysed and monitored in the context of international food price shocks, when they receive increased attention. As the literature on seasonality describes, high and fluctuating food prices are not a recent phenomenon for people in low-income countries where food needs are satisfied via a combination of own production and market purchase (Chambers et al. 1981, Longhurst et al. 1986, Poulton et al. 2006). Economies that are characterized by lower levels of technological complexities in the production process[16] show cyclical food price increases in the lean season, due to the depletion of food stocks in the months ahead of the harvest (Hauenstein Swan et al. 2010). The literature also suggests that the transmission of the 2008-2009 global food price increases to the local markets, induced households to adopt livelihood mechanisms similar to those generally adopted during seasonal prices fluctuations (*Ibid.*). Such damaging coping mechanisms (i.e. limiting the consumption of nutrition foods or decreasing meal frequencies) can have deleterious effects on nutritional status of the most vulnerable with long lasting effects on health and wellbeing (Hauenstein Swan et al. 2010, Ruel et al. 2010). The MCES is based on a methodology that can adequately represent both global food price shocks as well

[16] For example, these production systems can be featured by absence of irrigation systems and use of high yield seeds.

as more localised price increases and reinvigorated the importance of seasonality in the dominant debate on food and nutrition security.

2.4 Conclusions and Research Questions

Tackling persistent food and nutrition insecurity in a timely and effective manner has received considerableattention in the development agenda after the 2008-2009 food price crisis. Yet, there are conflicting views on the effects of recent food price rises on food and nutrition security and there is a widespread dissatisfaction with existing indicators and measures of food insecurity as regards their capacity to gauge and monitor the impacts of shocks on poor populations' food insecurity.

The chapter provides a description of some of the shortcomings of using real food prices relative to US CPI or other international price indices in interpreting the effects of food price shocks on food and nutrition security. The main drawback resides in the fact that the deflators used to calculate such indices are higher for growing and high-income economies and people compared to indices of those that have stagnant and low-income. Such methodological issue artificially reduces the magnitude of real food price increases uncovering discrepancies over the "real" effects of food prices on poverty and food and nutrition security.

Plausibly, increases of food prices can generate positive outcomes in the long run, by offering marketing opportunities to food producers, incentivise productivity and increase labour demand in agriculture that could be remunerated with higher wages. However, higher and volatile food prices can have detrimental effects in the short-run, where the nutrition status of the most vulnerable can be dramatically affected before the manifestation of the positive outcomes.

The urgency of alternative of changes in real food prices and their impacts are widely recognized (Dorward 2013, Headey and Ecker 2012, de Haen et al 2011). It is argued that timeliness and use of available data are important principles in the choice of measures. Following Andrew Dorward's intuition on alternative measures of real food price changes that are relevant to the analysis and discussion of staple food prices in low-income economies (Dorward 2011, 2013), the thesis proposes and develops the MCES, a novel methodology to improve the measurement and monitoring of the impacts of food price changes on food and nutrition security. On this basis, three research questions aimed at exploring these issues are formulated:

1. Is the methodological approach developed by the MCES able to overcome some of the shortcomings of using food prices in real terms for measuring the impacts of food price fluctuations on food and nutrition security of poor population in low-income countries?

a) What are the repercussions of food price fluctuations on food and nutrition that the MCES captures in a more accurate way?
b) Does the property of disaggregating the MCES by income groups provide a better understanding of the mechanisms through which food price fluctuations impact food security and nutrition status of different segments of the population?

c) Can the MCES contribute to evaluating the role of seasonality on food and nutrition security?

2. Bearing in mind the need to measure and respond to food price shocks in a timely and effective manner, is the MCES a viable alternative to individual real food prices for monitoring the effects of changing food prices on food and nutrition security?

Research question one is broken down into three sub-questions (1a, 1b, 1c) and address different aspects deemed important in assessing the effectiveness of the MCES as a food price index sensitive to changes of food and nutrition security of poorer segments of the population: (i) manifestation of the phenomena that is better captured; (ii) disaggregated impact by income group; and (iii) the role of seasonality. The second question addresses the call for pragmatic and cost-effective methodological development to monitors and report food and nutrition security in a timely manner.

These research questions and key sub-questions are addressed by employing an interdisciplinary approach, grounded in micro-economics and nutrition, considered to be effective in the conceptualization of the MCES and its validation process at the household level. In this thesis, the validation process aims at evaluating the effectiveness of the MCES in assessing, monitoring and reporting changes of food and nutrition security of poorer segments of the population.

Chapter 3 The MCES: Theoretical background, rationale and methodology

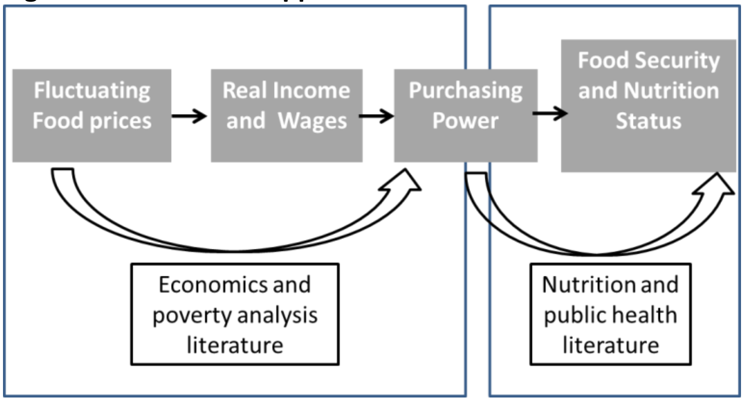
Introduction

It is increasingly recognised that complex issues such as food security and nutrition need an integrated and multi-sectoral approachto be adequately understood (Haddad et al. 2016, Jones and Ejeta 2016, Dorward and Dangour 2012). Therefore, this thesis addresses food and nutrition security in relation to food price fluctuations using an interdisciplinary perspective. The development of the methodological strategy represents a central component of this work, where the conceptual and the methodological approaches are informed by the fields of agricultural economics and nutrition. The interdisciplinary perspective encompasses the conceptualisation and development of the MCES as well as its validation (i.e., the assessment of its effectiveness in terms of relevance for the interpretation of food and nutrition security of poor population in low-income countries).

The thesis is composed by two methodological stages: one is related to the development of the MCES (described in this Chapter) and the other one related to the validation of the indicator (described in Chapter 4).

The present Chapter exposes three aspects of the indicator. First, it provides an overview of the theoretical approaches at the core of the MCES that complement the literature review presented in section 2.2 of Chapter 2. This is graphically illustrated (again for the convenience of the reader) inFigure 3.1. In interpreting the effects of food prices on food and nutrition security two levels of analysis are considered: the left hand side of the graph represents the interaction between food prices, income and wages and how it determines purchasing power. This is analysed through the micro-economic theory of consumer behaviour and economy wide processes in poor agrarian economies (Section 3.1.1). The left hand side of the graph represents the linkages between purchasing power variations in food security and nutrition status, examined through theoretical and conceptual frameworks pertinent to nutrition and public health (Section 3.1.2).

Figure 3.1Theoretical approaches of the MCES – a two level multidisciplinary analysis



Source: Author

The chapter continues by defining the rationale within which the MCES operates (Section 3.2), hence consolidating the theoretical framework derived from micro-economics and nutrition literature. The remainder of the chapter presents the methodological steps to calculate the MCES at the household level and discusses a number of conceptual aspects linked to each component of the indicators.

3.1 From food price increases to food and nutrition security: theories and approaches from micro-economics and nutrition

The two analytical blocks presented in It is increasingly recognised that complex issues such as food security and nutrition need an integrated and multi-sectoral approachto be adequately understood (Haddad et al. 2016, Jones and Ejeta 2016, Dorward and Dangour 2012). Therefore, this thesis addresses food and nutrition security in relation to food price fluctuations using an interdisciplinary perspective. The development of the methodological strategy represents a central component of this work, where the conceptual and the methodological approaches are informed by the fields of agricultural economics and nutrition. The interdisciplinary perspective encompasses the conceptualisation and development of the MCES as well as its validation (i.e., the assessment of its effectiveness in terms of relevance for the interpretation of food and nutrition security of poor population in low-income countries).

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, represent the theoretical foundations that inform the conceptualisation of the MCES. The following sections discuss the theoretical approaches adopted in the formulation of the indicator, complementing the literature review (Section 1.2 in Chapter 1). Each theoretical block is discussed separately. First, the section defines consumer behaviour theories for consumption and production of food, narrowing the general discussion on the effects of food prices on real income to food consumption and production (sub-Section 3.1.1). Standard micro-economic theory is presented before its limitations are identified and a granular picture relevant to poor population in low-income countries with dominant agricultural sectors is articulated. This critical review expands on Dorward's work (2012) on the short and medium term impacts of staple food price increases. The Section that follows (3.1.2) covers the second theoretical block that incorporates the nutritional implications of fluctuating food prices to the overall theoretical framework. Separating the effects of food price changes on food and nutrition security in two stages is chosen to simplify the theoretical analysis at the core of the MCES. However, it is possible to integrate nutrition directly in models that look at the first level of food price impacts, providing a link between food prices and nutrition within a single model. A brief discussion of these models is incorporated in the following sections.

3.1.1 Microeconomic theory of impacts of food prices on income and purchasing power

Microeconomic theory of food consumption is often analysed within consumer preferences theories that provide simple assumptions about what shapes rational behaviours. As Timmer et al. (1983) state, microeconomic theory *"explains each purchase of a commodity as a function of the consumer's income, the prices of the commodities, and individual preference"* (p.12). Consumers enter the marketplace (that offers a range of commodities in different qualities and amounts) with a certain purchasing power and preferences for different goods. Therefore, consumers relate their choices (desired goods) to available goods, but their choices are, in turn, dictated by disposable income and the prices of the commodities available for purchase[1]. Economic theory explains how desired choices and available choices are reconciled via rational decision-making and individual preferences (Timmer et al., 1983). The uniqueness of the individual preferences implies a great diversity in how various individuals will react to

[1] Microeconomic theory refers to these concepts in terms of indifference curves and budget lines. While acknowledging this body of literature and its formalization, this section opts to keep an intuitive explanation to refer to this literature.

changes in income and prices, a diversity that is predicted by economic theory on consumer preferences, and not incompatible with it.

Formally, the conventional entry point to the analysis of the welfare implication of food-price changes is to estimate the welfare effects in terms of compensating variation of consumer surplus. The Hicksian method for compensating variation is:

Equation 3.1

$$\Delta E^h = E_h(p^1, u_h^0) - E_h(p^0, u_h^0)$$

Where E^h indicates the minimum expenditure that allows household h to reach utility (u_h) given the price vector p_h of goods and services (the superscript 0 and 1 refer to the value of the variables observed, respectively, before and after the price change). Following the Ferreira et al. (2013) formulation, the first-order approximation for discrete price changes gives the compensating variation defined as:

Equation 3.2

$$\Delta E^h \cong \sum_i q_i^h \Delta p_i$$

Where q_i^h is the quantity of good i consumed by household h. As price changes are expressed in percentages, the proportional formulation of Equation 3.2 is often adopted. This means that quantities are replaced by budget shares (w_i^h), the key variable that intermediates the effect of price changes on welfare:

Equation 3.3

$$\frac{\Delta E^h}{E^h} \cong \sum_i w_i^h \frac{\Delta p_i}{p_i}$$

Because food producing households are an important component of the analysis, they are incorporated by adding the value of production (σ_i^h where h denotes the household and i the produced good) in Equation 3.3 as a portion of the total consumption expenditure of the household:

Equation 3.4

$$\frac{\Delta E^h}{E^h} = \sum_i \left(w_i^h - \sigma_i^h\right) \frac{\Delta p_i}{p_i} + S\,(\Delta p)$$

Where $S(\Delta p)$ is a function of all price vectors of price changes that represents the substitution effect (described in the next paragraph). Ferreira and colleagues (2013) go on to incorporate labour market effects, a criterion that will not be considered here since its analysis and incorporation would go beyond the scope of this thesis.

In this theoretical framework, price changes generate two effects on consumerdecisions-making: the **substitution effect**, which is defined as a reduction of purchase and consumption of goods whose prices have risen and as an increase of purchase and consumption of (relatively) inexpensive products; the **income effect**, a decline of real income driven by an increase in the total cost of purchases that generates a downward pressure on the acquisition of goods and services. The balance between the two effects is mainly driven by: i) the relevance of the good or service affected by the price rise on the total expenditure; and ii) the marginal utilities of the basket of goods and services of each individual. For poorer consumers, who spend a larger share of their income on food and other basic goods, such essential products and services provide a relatively higher marginal utility. Therefore, when prices of food increase, real income and utility of poorer consumers are negatively affected.

In his article on the short and medium-term effects of staple food price increases on poor agrarian economies, Andrew Dorward (2012) provides an analytical framework in which such effects are disaggregated. The framework also takes into account, on the one hand, the temporal dimension within which food price effects are propagated and, on the other hand, the household's position in the spectrum of food production and consumption. By identifying key factors for establishing the direction of impact of food price increases on poor population's real income, Dorward (2012) suggests that these are not defined *a priori* andare conditional to context specific characteristics, to the economic structure and to the amount of food consumers and food producers within the economy. In particular, Dorward adopts Deaton's (1989) distinction between household categories that populate the food production and consumption interactions:

Net-food sellers,are defined as households and individuals whose sale of food exceed their food consumption;

Net-food buyers, are households and individuals for whom the total purchase of food is greater than the total sale of food on the market;

Pure consumers is an analytical intermediary that refers to urban households and rural landless households (that is, households and individuals that work in rural areas in agricultural and non-agricultural activities as wage workers) that are not involved in food production for own consumption and acquire food via market purchase.

In defining how these actors interact, Dorward (2012) considers a two-fold linkage between production and consumption: on the one hand, he looks at decision-making process between production and consumption within the household and, on the other hand, at decision making between producers and consumers via market interaction[2].

Within this framework, direct and short term effects of food price increases on poor (net and pure) consumers will be negative. Given the high priority of food expenditures to which a large proportion of income is devoted, sudden increases of food prices can generate negative income effects, leading to a dramatic depression of disposable income as households have little room to adjust their food and non-food consumption patterns. The substitution effect for such households is also limited, as their consumption is already pushed to the cheapest option. When food and essential non-food consumption experience declines significantly, damaging consequences on nutritional status and health can emerge with lasting consequences on the physical and cognitive development of children as well as wellbeing of other household member's.

On the other side of the spectrum, food price changes can be beneficial to net-food producers. Producers will react to the variation of food prices by modifying the resource distribution to produce competing products and by shifting input utilisation (*ibid.*). The outcome of how resources are allocated between competing products represents the **substitution effect**, between the production of goods whose prices and profitability have increased and the production of products which are now relatively inexpensive and therefore less profitable. On the other hand, the **profit effect** (Singh et al. 1986) – that denotes the profit maximisation by setting input use and associated production at the point where marginal revenue product matches the marginal cost – will determine the demand for labour and the use of other production factors.

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[2] The analysis of the first type of linkages takes place within the Farm-Household models (Singh et al. 1986) and the Net-Benefit Ratio (Deaton 1989), while the second one is approached via partial equilibrium analysis. Dorward (2012) suggests Christiaensen et al.2011, Delgado et al. 1998, Dorward et al. 2003, Haggblade et al. 1989, and Haggblade et al. 2007 among others for a review on partial equilibrium analysis.

The first section of Figure 3.2 Figure 3.3 graphically illustrates what is described above. The interaction between food price fluctuations with real income and wages, which determines the purchasing power of households and individuals, can generate positive short-run impacts on net-food sellers (who can benefit from an increase in productivity and sales depending to their availability and access to capital). During the same temporal frame, net and pure food consumers can be adversely affected by food price increases with significant declines of their real incomes. The magnitude of the negative effect on these groups will depend on their ability to absorb or buffer negative effects. The ability to do so is dictated by the disposable income in place and the possibility to access alternative channels in a timely way in order to maintain consumption levels.

Figure 3.2 Figure 3.3 Short, medium and long term impacts of food price increases on real income and on the economy and factors determining their direction.

	Impact of high food prices on real income
	Short and Medium term
Net-food producers	++/+++
Net-food buyers	.../-
Pure consumers	-/--/---

	Long-term Impacts on the economy, incomes and poverty		
Factors	Positive (poverty reduction and increased real income)	⟷	Negative (poverty increase and reduced real income)
	Access to capital	⟷	Lack of capital
	High % of surplus producers	⟷	High % of deficit producers
	Large number of wealthy consumers	⟷	Large number of poorer consumers
	Low input prices	⟷	Increasing input prices and price transmission
	Controlled price volatility and price transmission	⟷	High price volatility

Legend:
++/+++: increase and large increase
-/--/---: small or large decrease
... : indeterminate

Source: Author, adapted from Dorward (2011).

In the medium and longer term, the implications of food prices on welfare and poverty reduction are context specific and depend on factors briefly summarized in the lower section of Figure 3.2 Figure 3.3. Although the long-term effects of food price changes on FNS go beyond the rationale and area of operationalisation of the MCES, it is a relevant discussion to the general theme of this thesis. In particular, it speaks to some of the studies reviewed in section 2.2 that emphasised the positive repercussion of high food prices on poverty (Headey 2016, Jacoby 2016, Aksoy and Isik-Dikmelik 2008). The preconditions for positive outcomes are often missing in low-income countries. In fact, indirect and long term effects of high food prices can manifest through agriculture supply response and consequent increase in the demand for labour and upward adjustment of wages. These, in turn, can generate real income increases, poverty reduction and general positive outcomes on the economy via consumption linkages. However, such outcome is highly dependent on a number of factors. According to Dorward (2012), since food prices increases tend to depress real incomes of net-food buyers, a positive response of food prices on the overall economy and poverty reduction necessitates that net-food sellers outweigh net-food buyers in order to increase production via investments in technical change that increases labour demand and boosts wages. In addition, there needs to be substantial generation of income that injects positive consumption linkages and raises rural labour demand and wages. In poor rural areas and urban economies, where deficit producers (and pure consumers) outnumber surplus producers and where access to seasonal capital (to invest in production) is limited, these conditions will not apply. The lower section of Figure 3.2 Figure 3.3summarises some of the factors that define the direction of the impacts of high food prices on poverty. They include: i) access to seasonal capital to allow increased investment as a response to higher food prices; ii) the features and composition of producers and consumers; iii) controlled input prices that do not erode the profit effect; iv) controlled levels of food price volatility.

The impacts of high food prices on real income, purchasing power and welfare cannot be determined *a priori* and are determined by a number of endogenous and exogenous factors and their interaction with the overall structure of the economy. Some of said factors and their interactions are often missing in many poor countries as agriculture is highly seasonal, operates with low levels of mechanisation and irrigation systems and a large proportion of the land is farmed by people who are poor with severe working capital constraints.

The following section links the discussion on the effects of food price changes on purchasing power to the theoretical approaches that translate such impacts on food and nutrition security mainly by adopting the UNICEF conceptual framework of undernutrition (UNICEF 1990).

3.1.2 Connecting food price changes to nutrition security

As mentioned in Chapter 1, the nutrition literature recognizes three common factors that hamper nutrition: (i) household food insecurity (in terms of availability and food utilization); (ii) inadequate care; and (iii) unhealthy environment (UNICEF 1990). Although there is a vast literature corroborating the importance of the three elements and their interaction in determining nutritional outcomes, there is a gap in terms of a well-recognized and validated nutrition production function. Kirk and colleagues (2015) offer a production health function that focuses on nutritional outcomes[3]:

Equation 3.5

$$H_i = H(f_i, n_i, s_i, X_i)$$

where H_i is the household or individual i health, expressed as a function of f_i (food consumption), n_i (care and nurturing), s_i (sanitary environment) and X_i (household or individual characteristics). When looking at food price effects on H_i the time element is introduced that modifies Equation 3.5 as follows:

Equation3.6

$$H_{it} = H(f_{it}, n_{it}, s_{it}, X_{it}, H_{it-1})$$

With t indicating the period after the price change, and H_{it-1} representing nutritional health before the price change. Conceptually, income and nutrition are connected using a utility maximisation concept, implying that households or individuals might value directly health (H) or its individual components. A more generous formulation entails:

Equation 3.7

$$U_{it} = U(f_{it}, n_{it}, s_{it}, c_{it}, l_{it}, X_{it})$$

that includes other consumption (c_{it}) and leisure (l_{it}). As any utility maximisation, households will maximise this utility function subject to their budget constraint defined as:

Equation 3.7

$$p_f f_{it} + p_s s_{it} + \ p_c c_{it} - w(n_{it} + l_{it}) \leq I_{it}$$

and p_f, p_s, p_c, w, I_{it} denote the prices of food, sanitation and consumption, wage rate and income (which can include farm profits, non-agricultural income, value of household labour and land endowment).

Sudden and unexpected food price fluctuations demand rapid adjustment in terms of budget allocation and vulnerable households may adopt different strategies with regard to their diets

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[3] Although, the specification of these models go beyond the scope and purpose of this work, the thesis acknowledges their formulation. Moreover, while this work opts to divide the impact of food prices on food and nutrition security in two components (using purchasing power as a hinge), other studies have incorporated nutrition directly in farm household models, providing a direct link between food prices and nutritional outcomes (such as Kirk et al. 2015).

(Darnton-Hill and Cogill, 2010; Ruel et al., 2010). When the purchasing power of vulnerable groups are hindered, it will affect the quality and quantity of food that is affordable, while also reducing the resources for essential non-food consumption (such as health and care expenditure, water, sanitation, schooling and other essential services).

At the household and individual level, food intake reduction takes place in two phases. Firstly, diets become less diverse and poorer in micronutrients; more specifically, they become predominantly composed of carbohydrate staples. This response to income depression occurs because meeting calories requirement is a primal need and staples are generally more affordable sources of energy than most animal source foods, vegetables and fruits (Brinkman et al. 2010). Monotonous diets composed predominantly of staples, may maintain adequate energy intakes levels, but are likely to be nutritionally inadequate in micronutrients, protein and fats (Thompson 2009). Risks of stunting, micronutrient deficiencies (hidden hunger) and associated poor health outcomes increase, with serious effects on children, pregnant women, the elderly, and the ill within the household.

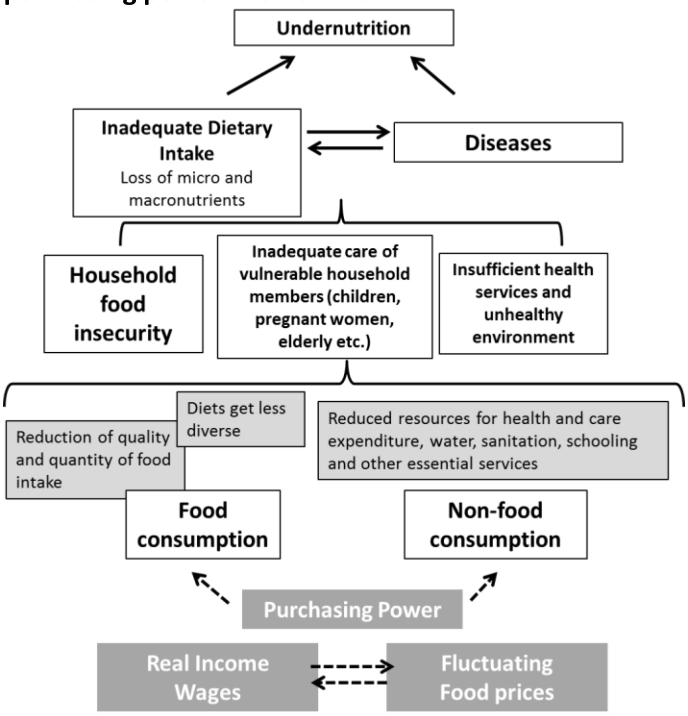
The second phase takes place when prices rise further or when adequate policies to protect the food purchasing power of vulnerable groups (i.e., social protection mechanisms) have not been put in place. Food portions and frequency of meals may be affected resulting in decreased energy intakes in addition to reduced micronutrient intakes. The Deterioration of dietary quality coexists with a reduction in total caloric intake that increases the probability of health shocks which can instigate a vicious cycle of malnutrition and disease further exacerbated by reduced resources to health services and medication (Meerman and Aphane 2012). Inadequate dietary intake for a prolonged period of time undermines the immune system and exposes individuals to infectious diseases[4]. Infectious diseases, on the other hand, increase nutrient requirements and further jeopardise the immune system. This vicious circle can begin when dietary intake is inadequate in terms of quality and worsens when energy requirements are not reached.

Figure 3.4, a modified version of the original UNICEF framework (1990),identifies three levels of causes of undernutrition. This research focuses on the basic causes pertinent to food price fluctuations and purchasing power (at the bottom of the diagram) and links them gradually to

[4]Among differentdeterminants of child growth deterrents (stunting), infectious diseases have been identified as one of the most important ones(Scrimshaw et al. 1968). The role of diarrhoea appears particularly critical (Martorell et al. 1975, Black et al. 1984, Checkley et al. 2003, Assis et al. 2005)due to possible associations with suboptimal absorption of nutrients (Mata 1992)

the higher level causes identified by the framework. The dynamic between food prices, wages and income are the starting point of this work and help to conceptualise the basic elements at the core of the MCES, a simple and accessible short term food price indicator that can be meaningful to identify food and nutrition security challenges.

Figure 3.4. MCES theoretical framework: channels of impacts between food price fluctuation, purchasing power and nutrition



Source: Author, adapted from UNICEF (1990)

At this point, it is important to consider the role of own produced calories within this discussion, in the conceptualization of the MCES and its implication. Following the proposed classification, pure consumers will mainly rely on markets for their provision of food. Net-food consumers and net-food sellers will produce, consume and sell some (if not all) of their food. The characteristics of food production and sale will depend on various determinants that move along the lines of land ownership, land size and soil features, crops availability, access and availability of credit and markets. Agri-health analysis looks at the different pathways that link agriculture, nutrition and health, recognizing that agriculture can play a major role in improving nutritional status of farmers (and the rest of the society), although in complex and non-linear ways (Dorward and Dangour 2012). In this context, the impact of food price fluctuations on subsistence farmers is analysed (Dorward 2012). While on the one hand reliance on own food production may sustain food consumption during hardships or food price shocks, on the other hand the impact on nutritional outcomes is not always straightforward.

For example, as articulated by O'Laughlin (2013), dependence on own production, especially for poorer rural households can generate severe nutritional and health implications because they may rely on limited food variety. This can have serious implications especially among the most vulnerable (children in particular). For households with limited disposable income, reliance on own production of food during food price crisis, especially when prolonged over time, can push individuals to consume monotone diets and foods that when eaten excessively and with the wrong preparation (for example due to time shortage by household members in charge of food provisioning) can have adverse nutritional outcomes.

Technical limitations and limited data on quantities of calorie intake from own production made the inclusion of this aspect difficult. The MCES represents the potential/hypothetical market cost of a minimum amount of calories (and not actually calorie intake). It therefore serves as a signal of possible repercussions and not exact evaluation of calorie intake fall due to food price increases. It is however important to acknowledge, that in the medium-longer term, poorer agricultural households could suffer from severe nutritional consequences. Even if they can produce some of their calories, lack of disposable income to purchase nutritious and desired food can result in food insecurity and negative nutritional and health consequences.

The next section by explaining the feature and the rationale of the MCES, combines the theoretical elements discussed by microeconomic theory with the factors that affect the nutritional status of individuals.

3.2 MCES - Rationale and methodology

The break-down of the multiple impacts of food price changes (on net-food buyers and net-food producers, on food consumption and non-food consumption) emphasises the importance of differentiating between different population groups and different time-frames when analysing the effects of food price changes on food consumption and nutrition security. The differentiation between net-food buyer and net-food producer responses to price changes is a useful starting point to identify winners and losers. Dorward (2012) suggests the use of "relative prices" when looking at welfare effects of food price increases, pointing out that relative prices can be more accurate than individual commodity prices in real terms when the objective is to analyse nutrition security. In particular, he suggest to examine food prices relative to i) consumers income and prices of other products that they buy, and ii) prices of farm inputs and prices of other products that farmers can produce. The first set of relative prices are relevant to the effects of food price changes on net-food consumers welfare and the second set of relative prices are relevant to net-food producers (*ibid*.)

Variations of prices for different producers and consumers are more varied and complex than it is suggested by standard analyses and discussions that use single prices or international price indices. A key concern is to adequately gauge and monitor food security and nutritional impacts of food prices in the short run, even in the instance of positive long-term effects on rural employment, wages and poverty reduction. Having demonstrated that food price effects are different based on the scale of production and wealth of the household, the MCES is developed to represent a valuable short-term food price indicator for vulnerable segments of the population in low and middle income countries. Expanding on Dorward's previous work (2013), the MCES is defined as the expenditure required to meet essential calorific requirements divided by the total resources available, or simply:

Equation 3.8

$$MCES = \frac{Minimum\ calorie\ expenditure}{Total\ consumption\ expenditure}$$

In other words, the indicator expresses the share of the household expenditure required to purchase a portion of energy requirement from staple foods. It is also considered to be the cheapest way to purchase calories because the MCES includes staple foods only, which are in many contexts the most affordable food items as well as representing most of the energy intake of poorer households in low-income countries. The indicator, therefore, reflects the *minimum* cost of a portion of the household's calorie requirement (and not the total cost of achieving a functional and healthy life). Importantly, it does not incorporate the cost of total energy requirement nor it wants to represent the total energy intake of individuals or households.

The MCES can be calculated at different aggregation levels, for example at the household, national or regional[5] level, and it can be disaggregated for different income groups. In order to be relevant for nutrition status analysis (despite a number of caveats that will be discussed in Chapter 4) the MCES is validated at the household level[6]. Therefore, the remainder of Chapter 3 presents the methodology to calculate household specific MCES.

The formal specification of the **household levelMCES** is defined as:

[5]In this context, the regional represents an agglomeration of neighbouring countries (for example East African region, South-East Asian region).

[6]Chapter 3 describes the rationale, data selection and methodology of the validation process of the MCES at the household level.

Equation 3.9

$$MCES = \frac{\sum_{i=1}^{n}((P_x * w_x/K_x) * HHminKcal_i) * Time}{HHconsumption\_exp_i}$$

where

- P_x denotes the local price (per kg) of x^{th} staple food consumed by household i,
- w_x is the x^{th} staple food specific weighting factor, defined as:

Equation 3.10

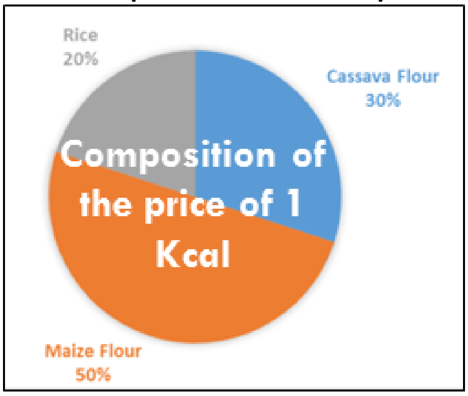
$$w_x = \frac{Kcal_x}{TOTKcal_{staples}}$$

  w_x considers the purchase share of calories of each staple food on the total staple food basket of the household, and not the share of calorie consumed. As per the Engels law, these values tend to be higher for poorer households compared to wealthier ones (as generally food share - and in particular staple food shares - decrease as income increases).

- K_x is obtained from country specific Food Composition Tables[7] and reflects the calorie density (energy expressed in Kcal per 100g) contained in each food item. Dividing the weighted food price of each staple to its calorie density, allows the calculation of an indexed price of one unit of calorie (Figure 3.5).
- $HHminKcal$ represents 60% of the minimum household energy requirement of household i. This is sensitive to the household composition and adult-equivalent conversion factors are employed.
- $Time$ refers to the time frame for which the indicator is constructed. The periodicity of the MCES is dependent on the household consumption expenditure data; if the latter is calculated on a monthly basis, $Time$ will equal 30 days.

[7] Food Composition Tables (FCT) list nutritionally important components of most food items and provide values for energy and nutrients. They include: protein, carbohydrates, fat, vitamins and minerals and other important food components (i.e. fibres). The databases are country specific and the data for this research have been obtained from the FAO International Network of Food Data Systems (INFOODS) a directory that gathers country specific FCTs dated back to 1988. The details about FCT used in this thesis are discussed in Chapter 5 and 6.

Figure 3.5 Composition of one Kcal price from staple foods*



*The graph represents the composition the price of 1 kcal derived from staple foods in a setting where the most important staples are rice, cassava and maize flour. The percentages are referred to their purchase share on the total staple food basket.

Source:Author

The conceptualisation and construction of the MCES makes it an appealing and relatively easy indicator in terms of data collection, computation and communication. Its results are presented in percentage terms with higher values for poor and food insecure households and low values for wealthier households who spend a smaller proportion of their income on food. For indicators that are used to monitor food and nutrition security status of poor population it is crucial to balance the need of comprehensiveness, on the one hand, with simplicity and timeliness, on the other. Local food prices are a valuable basis for the computation of indices that monitor food security in relation to food price fluctuations as they are widely available and increasingly collected in a timely way. Dorward (2013)conceptualised the Food Expenditure Ratio (FER) to address these challenges. The MCES draws from this experience and attempts to ameliorate its methodology and validity.

After the defining the elements of the indicator, the following two sections present conceptual consideration in relation of the numerator and the denominator of the household level MCES, of which some are revenant also to its calculation at higher aggregation levels.

3.2.1 The Numerator

The numerator of the MCES calculates the minimum cost to reach a portion of minimum daily calorie requirement. It does that by creating a weighted price index for one calorie () of a basket of representative staples foods. This includes **dietary staples** that are context specific and relevant to dietary patterns of poorer households. According to the FAO (1995) "*a staple* *food is one that is eaten regularly and in such quantities as to constitute the dominant part of the diet and supply a major proportion of energy and nutrient needs*" (p.21). The MCES, by including the expenditure for staple-foods only, considers one of the few food options for poor people in reaching minimum calorie intake in the cheapest and most efficient way. Healthy diets are composed by other dimensions, but for those in which food consumption is low it is a reasonable choice to restrict the attention to calories (Basu and Kanbur 2008). In addition, since they are common to most diets, staple-foods operate as common a denominator in standardising dietary patterns across countries and, therefore, in ensuring that there are no environmental or cultural restrictions in the validity of the indicator. The MCES opts for **most affordable prices** (locally produced products instead of imported ones and lower qualities instead of premium options) **weighted** against their purchase share on the total staple food basket[8]. This is then divided by the calorie content of each staple food (energy expressed in Kcal per 100g).

Food constitutes the bulk of consumption expenditure of poor segment of the population and staples purchase and consumption are particularly important for those that are calorie challenged. Spending patterns of poor households can be whittled down to few item groups: staple-food expenditure, mainly maize, sorghum, wheat, rice and tubers; minimum non-staple expenditure, such as basic minimum expenditure for items that are essential for survival but not prominent in providing food energy[9]; essential expenditure for inputs and investment into livelihoods, schooling, health service, and other basic assets; few discretional expenditure (Rethman 2011). Staple-food expenditure represents on average more than 50% of the total expenditure in poor households, and during shocks, income decrease and cyclical food shortage it raises up to 80% (Devereux, Sabates-Wheeler, and Longhurst 2011)[10]. Lipton (1986) defined, among other characteristics, the ultra-poor as spending some 80% of their income to low cost and energy-dense foods and consuming 80% or less of the minimum daily energy needs. In addition they face restricted opportunities to shift from expensive food to cheap

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[8]For example, if the main dietary staples in a country are maize, cassava flour and rice (the total staple food basket) the consumption share of each product is used as a weighting factor on prices. This offers a more accurate representation of the importance of each food item on the MCES.
[9]This includes other macro- and micronutrients foods that are necessary for individual survival, together with key expenditure on basic hygiene, clean and safe water, and other location specific obligations (taxes, education and health) as well as expenditure on energy (cooking and lighting) and, in the case of the urban poor, housing.
[10]Berton et al. (2013).

food (mainly carbohydrate energy-rich staple foods), since their food purchases are already largely devoted to cheap food.

$HHminKcal$ represents 60% of household adult equivalent energy requirement. The household adult equivalent reference scale accounts for variation in household composition and different individual energy requirements. It is internationally accepted that 2100 Kcal is the minimum daily energy requirement for an adult person (men and women between 19 and 50 years of age). This figure is based on the nutritional energy requirements of a standard population with a standard distribution of ages and genders (FAO, WHO, and UNU 2001). Once the reference calorie intake for the representative adult person is identified, the adult-equivalent fraction assigned to each individual is determined by the ratio between the calorie requirements (according to age, gender, and pregnant or breastfeeding status) and the estimated adult reference value (Claro et al. 2010). The use of the adult equivalent factor the MCES serves to reflectthe minimum calories needs based on the structure of the household. Because it is plausible to expect that not all calories derive from staples (in particular in rural and peri-urban areas that can produce some of their food) the MCES incorporates only a portion of the minimum daily energy requirement.

The MCES nominator considers the “worst case scenario” for the poor and the ultra-poor and calculates the cost to purchase 60% of adult equivalent minimum energy requirement. Such percentage corresponds with the average share of staple foods on total food purchase calculated in the household budget surveys used for the analysis. This method compensates for the fact that some households will produce some of their food (when this is possible) to buffer the initial adverse effects of food prices on food consumption. However, when price rises are prolonged in time, households are unlikely to produce all the food that they need and will eventually need to satisfy some (if not most) of their dietary needs by purchasing food. Self-sufficiency might be sustainable solution in the short and medium run but in the long term diets are at high risks of getting monotonous and highly dominated by staples.

3.2.2 The Denominator

Throughout this Chapter, it has been argued that in order to represent the impacts of food prices on food and nutrition security of poor parts of the population in a more adequate way, food price indicators should incorporate income effects of food price changes. Previous sections have also argued that real food prices relative to CPI can be ill suited to provide correct interpretation on the impact of long and short term food price changes on the food and nutrition security of poor income. Given that for this population group food accounts for a large share of their expenditure, the effect of changing food prices on welfare could be more adequately gauged using expenditure data (Dorward 2011).

A large body of the literature establishes the theoretical underpinnings of income and consumption expenditures as a measure of current and long-run household welfare (World Bank 2001; Deaton and Zaidi 1999; Deaton and Muellbauer 1980). While income is commonly used to measure and monitor welfare in high income countries, in societies with a large agrarian sector and self-employed population, income tends to be poorly estimated since information on farm income, housing services and capital gains are difficult to gather. In the context of poor economies consumption expenditure is often preferred as a proxy of welfare. Consumption expenditure includes both goods and services that are purchased and those that are provided from self-production (World Bank 2001). In addition, expenditure tends to level the irregularities of income (that can largely fluctuate over time) reflecting a more accurate measure of long-term wellbeing.

However, money metric measures of welfare are characterised by a number of limitations. Firstly, and most importantly for this thesis, the surveys that collect consumption expenditure data in low income countries are intermittent and often of low quality (Jerven 2013). Technical capacity of statistical bureaus, budget constraints and dependence on the country's policy design needs make consumption expenditure data unreliable, often methodologically incoherent and difficult to use for inter-temporal comparison (Sahn and Stifel 2003). Alongside the issues related to the frequency of data collection, there are various methodological criticisms on how consumption expenditure data are gathered and calculated. These data can be prone to measurement errors because they heavily rely on recall information, require information on use values of goods consumed (such as prices and nominal interest rates that are arduous to discern in low income contexts) (Pradhan 2000; Scott and Amenuvegbe 1990).

3.3 Reflections on the intra-household power of the MCES methodology

After presenting the rationale and the methodology of the MCES, the following section reflects on the indicator's purpose and limitations. The MCES, by combining the effects of food prices on real income in one metric, can operate as a proxy of food affordability offering window of interpretation of possible outcomes of food price fluctuations on household food and nutrition. However, nutritional status is an issue pertinent to the individual and household level analysis can overshadow intra-household mechanisms that shape food and nutrition security. This section offers an examination on the individual and intra-household “power” of the MCES and exposes some of the trends in the literature, the pragmatic or middle ground approach often chosen by researchers and practitioners, and describes on how individual and intra-household level analysis is integrated in the thesis.

Data that describes individual level food and nutrient intake and dietary patterns are critical for informing and signalling how economic and price shocks may affect different strata of the population. Dietary intake assessment methods at the individual level (such as 24-h intake recalls, and food frequency questionnaires) represent the scientifically accepted and golden standard data (especially by nutritionists) for quantifying individual nutritional intakes and therefore assess individual nutrition status. However, such data are expensive, complex to collect and often are not suitable in situations that require rapid assessments (Coates et al. 2017).

Given the gap generated by the lack of individual level data, a number of nutritionists, economists and poverty analysts have increasingly been using household surveys (such as household budget and household consumption and expenditure survey), considered particularly useful in low-income countries where household surveys are collected regularly and are nationally representative. Although the primary purpose of household budget surveys is not strictly related to nutrition analysis (for example, economists employ them to generate estimates for poverty analysis and monitoring) (Smith and Subandoro, 2007), the growing interest in their utility for food security and nutrition-related objectives have sparked a significant debate on their usefulness in nutrition analysis (Fiedler 2013; Lividini and Fiedler, 2015; Fiedler et al. 2012). There are indeed a number of recognized limitations in using and adapting household level data for nutrition analysis. Among the most relevant, household food intake cannot distinguish and quantify food intakes of individual household members (both for foods eaten at home and away from home), suffers from recall and information biases and it is unrepresentative of the intra-household interactions that shape the multiple experiences of food insecurity.

The comprehensive economics literature that examines intra-household resource allocation, recognizes the problematic implication that a unitary models of the household may cause in terms of policy implementation and impact assessments (Alderman et al., 1995; Haddad and

Kanbur, 1990; Haddad and Kanbur, 1992; Haddad et al., 1995; Behrman, 1997; Behrman and Deolalikar, 1990). Alternative theories suggests the coexistence of different decision making rules that explain unequal resource allocation. Studies on the empirical examinations of intra-household food and nutrient distribution point to the significant energy inequities. A study by Haddad and Kanbur (1992) conducted in the Philippines, calculates that neglecting the intra-household dimension of poverty analysis and using only household level data was likely to underestimate poverty levels by 20–40%. In their analysis Luo and colleagues (2001) examined intra-household inequities in the consumption of several nutrients and food groups in 8 Chinese provinces and concluded that significant differences in nutrient consumptions followed patterns shaped around age and sex (i.e. favouring men and adult household members). More recent studies (Dary and Jariseta 2012), that used data from Uganda in 2008 gathered for a food fortification programme, compared results of individual dietary intakes (from 24-hour diet recalls of children 24–59 months and women 15–49 years) with dietary intake estimates using household level data. They found that household level data tended to underestimate the consumption of fortified foods relative to the 24-h recall module.

The selection of the specific datasets represented a crucial part of the PhD and it represented the result of a careful compromise between best methodological practices in economics and nutrition science and the availability of information needed to compute the MCES and perform the validation assessment. The construct and the validation of the MCES have partly shaped around the availability of data sources (more details on the choice of the datasets is provided in Chapter 4). On the one hand, the calculation of the MCES requires market price data, information on household's composition and household expenditure and, on the other hand, the econometric models required for the validation assessment necessitate of comparator food and nutrition security indicators (at both household and individual level) and a wide range of comparator measure control variables. However, due to the scarcity of datasets that incorporate both levels of information (household and individual) and the absence of data on either market prices or monetary expenditure in nutritional assessments, the analysis had few options beyond using household level data offered by household budget surveys. Such databases incorporate household consumption modules and anthropometric measures for some of the household members, and therefore were considered adequate (although not perfect) to compute the MCES and perform the validation exercise.

It is therefore crucial to emphasize the purpose of the food price indicator developed in this thesis. Firstly, the MCES should be interpreted as a first entry point to identify adverse effects food price shock on food insecurity and nutrition at the household level. Although the numerator of the indicator considers adult-equivalent conversion factor to calculate the minimum household energy requirement, the MCES is a household level indicator of food price fluctuations and income decreases on food and nutrition security. It considers household expenditure at the household level, as individual level data on income or monthly expenditure are cumbersome to gather. Therefore, an exhaustive analysis requires further examinations and context specific investigations to determine who are the most affected population and what are the mechanisms within the household that mediate or exacerbate the effects of food prices fluctuations. Secondly, the methodology of the MCES allows different levels of disaggregation. The thesis explores the different mechanisms that shape the tensions between food prices and income generation through the lenses of seasonality and income distributions. The methodology of the indicator operates in the middle ground of how food prices are currently employed (i.e. at the national or international level) and the golden standard (individual level with intra-household information): it offers a tool to evaluate the inter-household and assess seasonal dynamics that determine the production of food insecurity as a result of food price shocks. Thirdly, the calculation of individual level MCESs is methodologically achievable. The indicator can be developed and analysed at different aggregation levels (a discussion on national level MCES is presented in Annex I) and further research on this domain would require data collected at the individual level.

The empirical analysis and the discussion of the findings in Chapter 5 and 6, attempt introducing the individual and intra-household dimension of the impacts of food price shocks when data is available. For example, individual anthropometric data for children and mothers and information on adults and children meals consumption (available in the Bangladesh case study), helped at disentangling the aggregate picture and investigate at possible short-term mechanisms in place to protect some of the members of the household from decreased access to food. Additionally, the effort to link MCES outcomes to individual nutritional status and intra-household dimensions is deepened by embedding qualitative literature to emphasize possible underlying factors and offer plausible explanations. However, the interpretation of anthropometric indicators in comparison to food price fluctuations requires particular attention, as these measures represent complex combinations of numerous economic, social and biological factors. Anthropometric measures should be expanded in a way that more household members are included and combined with information on cultural, social and economic factors that shape the effects of food price shocks on nutritional status of poorer households.

3.4 Conclusions

The chapter introduced the theoretical and methodological aspect of the MCES. The theoretical approach is twofold, composed by a micro-economic component and by nutrition analysis component, reflecting the interdisciplinary nature of this work. The second part of the chapter described the calculation of the indicator at the household level, presenting the rationale of its elements as well as the limitations in the methodology and data sources. The chapter ends with reflecting on the intra-household implication of the MCES, expanding the discussion to broader methodological and interdisciplinary issues.

The MCES, by linking the effects of food prices on real income can operate as a proxy of food affordability. This allows to interpret in a more adequate way possible outcomes in terms of food and nutrition security in the event of food price shocks. Besides, the proposed price indicator speaks also to the methodological issues deriving from the wide use of real prices deflated by the CPIs (presented in Chapter 2). Crucially, it attempts to incorporate the 'income effect' of food price increases in one indicator and therefore it can offer appropriate signals in terms of impacts of food price increases on food and nutrition security of different wealth groups. Additionally, it can offer an indication of the depth of the decrease in purchasing power (especially among the poor) as well as helping to identify whether other segments of the population have been critically affected. The income effect can be particularly detrimental for poor people given the restricted opportunities they have to substitute cheaper foods for more expensive foods in their diets (since they are already consuming cheaper foods) and because a large proportion of their income is used for food expenditures.

Chapter 4 Validation of the MCES: Aims, Data and Methods

Introduction

This chapter presents the second methodological block of the thesis, and it is dedicated to the description of the MCES validity assessment.An important, and often challenging, task in developing indices and measures in social science is to present sufficient evidence that they provide a *valid* measurement of the phenomenon they intend to tackle. As defined by Frongillo (1999, p. 507S) "*Validation is a process of determining whether a method is suitable for providing useful analytical measurement for a given purpose and context*".

The first section of the chapter (4.1) establishes the definition of the validation process and its guiding criteria. This is followed by the rationale behind the selection of the food and nutrition security comparator measures, against which the MCES is validated (Section 4.2). Considerations behind the identification of the Household Consumption Expenditure Survey (HCES) used in the MCES validation are given fundamental importance in the thesis. Ideally, primary data collection is preferred in empirical works, however, this thesis aims to offer pragmatic approaches that use existing data to measuring the effects of food price fluctuations on food and nutrition security, instead of reaching a perfect index that is data hungry. The use of secondary data is a conscious decision and an integral part of the conceptualization of the MCES. Section 4.3 discusses these considerations and presents the main features and sampling design of the selected HCES. Section 4.4 presents the empirical approaches of the MCES validation. Because implications on the MCES robustness are given a central importance and represented an important part of the validation exercise, robustness checks strategies are presented in Section 4.4.1. The section following after (4.5) addresses general considerations on doing interdisciplinary work, reflecting on the methodological implications for the disciplines involved. Section 4.6 emphasizes a number of ethical considerations and concludes the chapter.

4.1 Validation of the MCES – aim and criteria

The aim of the MCES validation is to assess the association between the MCES and a set of widely used food and nutrition security comparator measures at the household level. The core assumption is:

If the MCES proves to be consistent with commonly used and validated food and nutrition security indicators, it can be considered a useful monitoring tool on the effects of food price fluctuations on food and nutrition security at the household level.

This technique is in line with recent studies that looked at the validation of indicators of dietary diversity,experienced-base food insecurity indicators and food-consumption-related coping strategies (Headey 2013, Skoufias et al. 2013, Verpoorten et al. 2013, Hoddinott and Yohannes 2002, Maxwell et al. 1999).[1]

In the scientific literature, measurement often consists of representing properties and relations by assigning numbers through a process based on scientific principles and specific rules (Wernimont 1977). However, a measure will not provide a numerical assessment of the phenomenon *per se,* as *"measurement pertains to properties of things not to the things themselves"* (Eisenhart 1963, p.23). Within social science, scientific principles are often inadequate or unavailable for the nature of the phenomena they study. Therefore,the measurement becomes instrumental for aiding in the process of inquiry and understanding (Webb et al. 2006).

With the introduction of the MCES, this work attempts to improve the representation of the risks associated with food price fluctuations on the food and nutrition security of poor populations in low-income countries. The aim of validating the MCES is to verify its consistency with a set of food and nutrition indicators that capture different dimensions of the phenomenon. If the initial assumptions are correct, increases of the MCES (driven by food price increments or consumption expenditure deterioration) should be associated with the deterioration of food and nutrition security, measured in its different dimensions. Section 4.2

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[1]The work of Chung et al. (1997) set the path for studies that aim at assessing alternative indicators of food and nutrition security. Their study, by using mixed-methods,compares a broad range of alternative food security indicators (food consumption, household structure and composition, reciprocal exchange and assets) to benchmarkor golden standard indicators (caloric intake over time, household income and anthropometric indicators). The MCES validation follows the rationale used by Chung and colleagues (1997), but is unable to set benchmarks due to the nature of some of the comparator measures, like the Dietary Diversity Scores and Food Frequency Scores for which cut-off points are currently under debate. Thresholds levels for indicators that account for meals numbers (for adults and children) are difficult to set, especially when different population groups (with diverse dietary requirements) are aggregated under one indicator. For this reason contingency tables, which are commonly used in this type of exercise, are not included in the methodological framework.

presents the selected food and nutrition security comparator measures and reflections over their identification.

The methods used in the validation and the food and nutrition security indicators selected to test MCES validity are informed by the research questions (identified after the review of the literature in Chapter 2). In particular the MCES validation addresses the first research questions and its relative sub-questions (Table 4.1).

Table 4.1 Linking research questions and methods

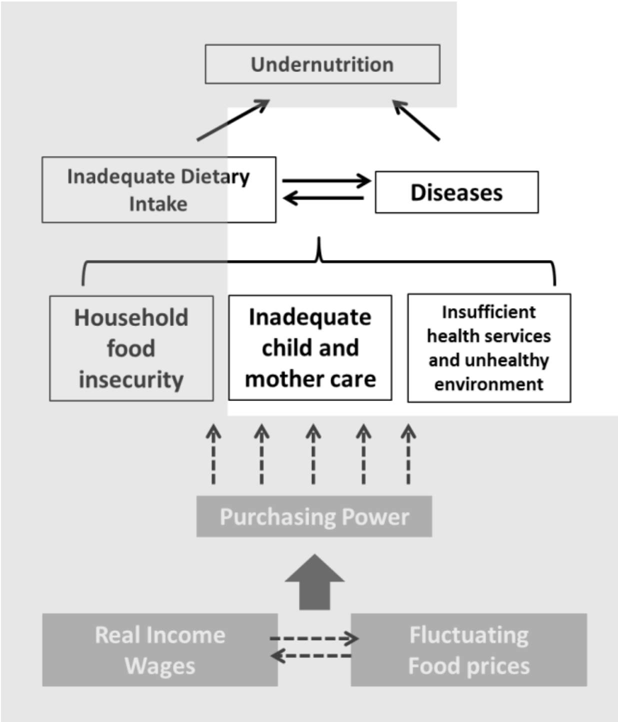
Question	Method and Empirical Strategy
1a) What aspects of food and nutrition security does the MCES capture in a more accurate way?	- Analysis of Pearson Correlation Coefficient. - Econometric evaluation of the association between the MCES and a set of food and nutrition security indicators reflecting different dimensions of the phenomenon.
1b) Does the property of disaggregating the MCES by income groups provide a better understanding of the mechanisms through which food price fluctuations impact food security and nutrition status of different segments of the population?	- Use of interaction terms between the MCES and expenditure quintiles in the econometric evaluation. - Evaluation of Marginal effects on the association between the MCES and food and nutrition security indicators over income quintiles.
1c) Can the MCES contribute to evaluating the role of seasonality on food and nutrition security?	- Use of interaction terms between the MCES and survey quarters in the econometric evaluation. - Evaluation of Marginal effects on the association between the MCES and food and nutrition security indicators over survey quarters.
1) Is the methodological approach developed by the MCES able to overcome some of the shortcomings of using food prices in real terms in measuring the impacts of food price fluctuations on food and nutrition security of poor populations in low-income countries?	- Assessment of the MCES robustness against individual staple food prices.

This work adopts the validation of the MCES at the household level. Firstly, household level analysis is an accepted practice in the domain of food security literature and gradually accepted amongst nutritionists (Murphy et al. 2012, Fiedler et al. 2008, Maxwell and Smith 1990). Secondly, consideration on available datasets played an important role in selecting the level of the empirical analysis.

HCES represent valuable secondary data sources, which are collected on a regular basis and routinely conducted in several low-income countries on nationally representative samples. However, it is important to remember the limitations of using HCES to perform nutrition analysis. In particular the difficulties of quantifying intakes of the individual household members (at home and away from home) and representation of interactions between members that are fundamental to the experience of food insecurity (Fiedler et al. 2012, Murphy et al. 2012).

Using a set of econometric assessments, the MCES validation assessed the association between the indicator and food and nutrition security comparator measures. Figure **Error! Reference source not found.**4.1 modified version of the UNICEF (1990) undernutrition framework delineates the boundaries of the MCES validation assessment (the area under the grey shadow). The validation, therefore, attempts at isolating (by controlling for confounding variables) the effects of the MCES on household food access, dietary intake and individual nutritional status.In particular, different econometric methods examine the association between the MCES and (i) Household Access to Food, (ii) Household Dietary Intake, and (iii) Child Nutrition Status (as illustrated in Figure 4.1 under the grey area) This area defines the research boundaries.

Figure 4.1 Micro-validation boundaries



Source: Author, modified version of the UNICEF undernutrition diagram (UNICEF 1990)

At this point, it is important to mention the limitations of this exercise and of the MCES, especially in relation to the association assessment between the MCES and nutrition security indicators. Given the holistic nature of the concept of nutrition security, nutrition status is determined by factors other than food intake. It can be said that by moving towards the top of the diagram illustrated in Figure 4.1, the more immediate and direct effects of food price changes are diluted with several other factors such as care, unhealthy environment and lack of health services, and finally, disease.

The MCES validation empirical strategy and the choice of the food and nutrition security comparator measures is informed by household food strategies and coping mechanisms literature pertinent to food price shocks, seasonality and famine[2]. The identification of the food and nutrition security indicators is guided by the different strategies that households adopt in face of sudden food price fluctuations. They include increased consumption of cheaper, often less preferred and lower quality food to protect energy intake. Low-income families might start buying less food, skip meals or reduce overall food intake while decreasing or cutting intake of non-staple, less energy-dense, more expensive foods (namely, foods that are the greatest source of bioavailable micronutrients). This can be accompanied by intake of less preferred foods, modification of cooking methods or the introduction of new ingredients

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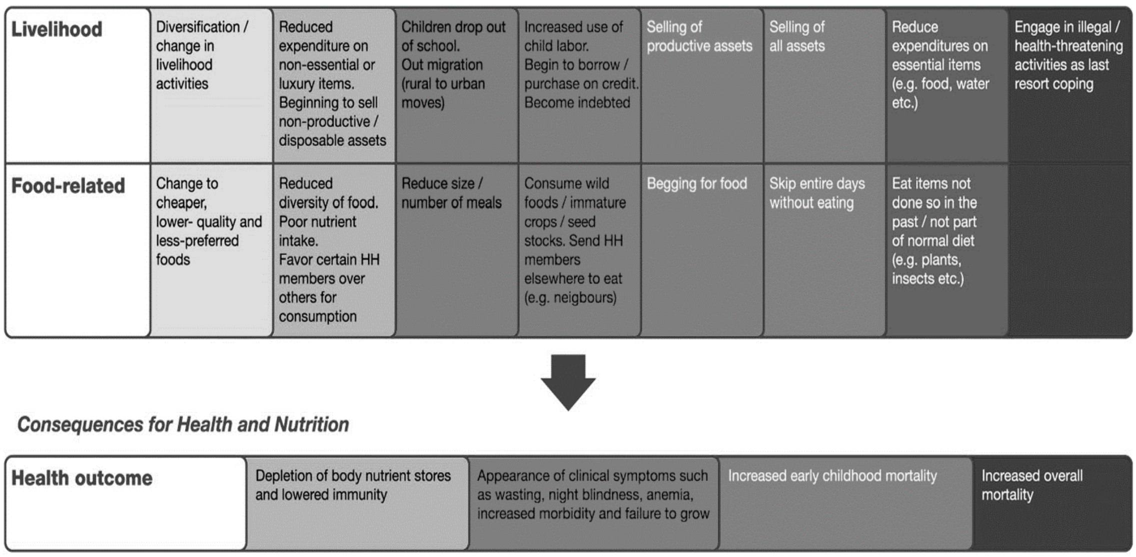
2Darton-Hill and Cogill 2010, Klotz et al. 2008, Marxwell et al. 2003, Longhurts 1986.

to give more flavour to poor quality food (such as spices). With the persistence of the crisis, individuals may engage in begging activities, skip eating for entire days and consume "*famine foods*" (Longhurst 1986, 32), such as wild foods which were not part of the diets and in normal times would be consumed by the very poor. Within the household, allocation of food can be modified, and in particular women can act as buffer for their children by cutting their food consumption and/or keeping high-quality food for their children and husbands (Ruel, 2010). This process is illustrated in Figure 4.2 that lists the above mentioned food strategies and more general livelihood strategies that contribute to deepen the severity of health and nutritional outcomes.

Figure 4.2. Food and nutrition insecurity, household livelihood and food strategies and health consequences[3]



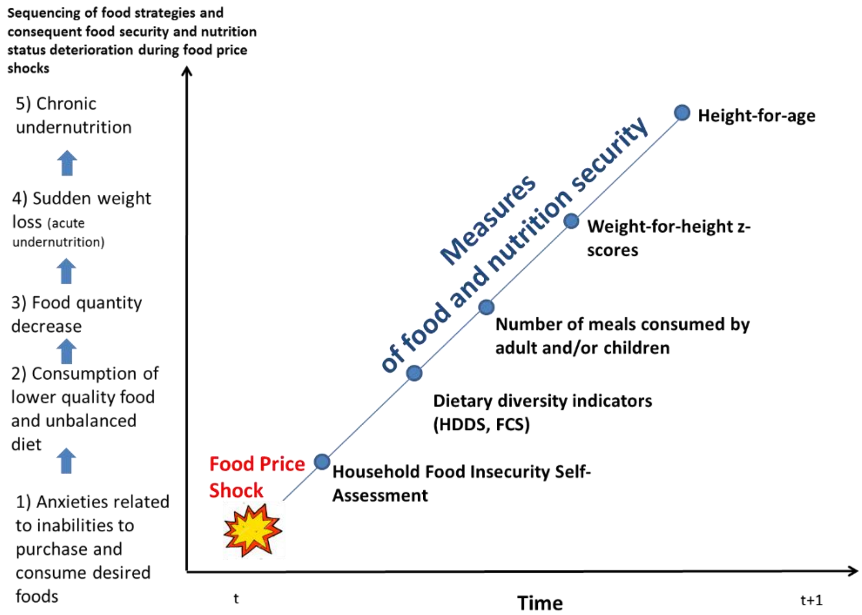
Source: Darton-Hill and Cogill 2010, adapted with permission from Klotz et al. 2008.

The analytical framework and rationale of the validation assessment is illustrated in Figure 4.3. The graph connects household and individual livelihood strategies during hardship to measurement methods that capture critical food and nutrition security outcomes of such strategies. The vertical axis lists the sequencing of possible manifestations of food and nutrition security deterioration in the event of food price shocks. The horizontal axis illustrates the temporal dimension of the food and nutrition security deterioration, from the outbreak of the food price shock (t) to its aftermath (t+1). Food and nutrition insecurity intensifies with time if not adequately addressed. Adding also the psychological dimension pertinent to the anxiety over the ability to purchase food at the first stages of the price shock, other food

[3]Klotz and colleagues (2008) framed the sequential graph using data and analysis by Maxwell et al. (2008)

strategies include decrease of dietary variety and food quantity that can translated in physical repercussion of undernutrition and poor health.

Figure 4.3. Micro-validation conceptual framework: linking household strategies to measures of food and nutrition security



Source: Author

The graph matches each of the outcomes with possible measurements tools, as indicated in Table 4.2:

Table 4.2 Linking livelihood strategies to food and nutrition security measurements

Livelihood/coping strategy linked to food prices increases	Measurement of food and nutrition security
Anxieties related to the ability to purchase food	Self-assessed and experienced-based food security measures
Consumption of low quality food and decreased dietary variety	Household dietary diversity measures
Sudden weight loss	Wasting
Chronic undernutrition	Stunting

The MCES validation systematically evaluates the association of the MCES against the above mentioned measurement methods used to gauge different manifestations of food and nutrition security deterioration. Once the comparator measures have been selected, the practical steps that shaped the MCES validation exercise are:

1) Identification of household budget surveys that includes data on staple prices, household socio-economic information, child anthropometric measure, food intake data and self-assessed food security information. This data allowed the computation of the MCES, FNS indicator and control variables.
2) Estimation of the MCES at the household level calculated for different expenditure groups.
3) Identification and implementation of econometric methods to evaluate the association and direction of the relationship between the MCES and the comparator measures. Different regression techniques are employed to analyse the association between the MCES and food security and nutrition measures. The estimate coefficient associated with the MCES is the coefficient of interest, when controlling for other confounding factors.

To achieve its objectives, the study uses quantitative data from two nationally representative HCES collected in Mozambique and Bangladesh during the 2008-09 food price crises. Section 4.3 provides an overview of the process and considerations that guided the identification of the case studies.

4.2 Food and nutrition security comparator measures: definitions and considerations

There are no shortages of food and nutrition security indicators. In particular, in the domain of food security measurement, such proliferation emphasizes the elusiveness of this concept and lack of agreement between agencies and practitioners on an effective and common approach (Barrett 2010). In order to ensure that different dimensions of food and nutrition security are taken into account, the validation assesses the association between the MCES and indicators belonging to two different classes of household food security measures (Cafiero et al. 2014): *Food Consumption Adequacy* (in particular household dietary diversity indices) and *Experienced Based Food Security Measures* (i.e. questions asked directly to the head of the household on perceptions and experience of food insecurity). The study then analyses the association between the MCES and *Growth-monitoring indices* for children (in particular wasting and stunting). Table 4.3 illustrates in detail the break-down of the comparator measures by country and by class of indicator.

Table 4.3. Comparator measures used to validate the MCES: break-down by country and class of indicator

Case Study	Food Security		Nutrition	
	Dietary Diversity indices	**Experienced Based Measures**	**Anthropometric indices - children (<5 y)**	**Anthropometric indices - adults**
Mozambique	Household Dietary Diversity Score (HDDS)- 12 food groups	Whether the family had experienced food insecurity during the month preceding the interview (yes-no)	Child wasting (by WHZ)	
		N. of meals eaten the day previous the interview (0-3) by the household	Child Stunting (by HAZ)	
Bangladesh	Food Consumption Scores (FCS)	Whether the family had experienced food insecurity during the month preceding the interview (yes-no)	Child wasting (by WHZ)	Maternal wasting (by MUAC)
		N. of meals eaten the day previous the interview (0-3) by adults	Child Stunting (by HAZ)	
		N. of meals eaten the day previous the interview (0-7) by children		

Before moving on to the description of each outcome variable, there are two important to considerations to put forward. This work acknowledges that none of the above mentioned indicators are free from conceptual and analytical limitations. The selection of these indicators is dictated by the combination of careful consideration of best practices in measuring food security and nutrition, on one hand, and restrictions imposed by the surveys and availability of data, on the other.

The remainder of this section will describe each comparator measure used in the validation, discussing their characteristics as well as their limitations.

Dietary Diversity Indicators have become increasingly popular for a number of reasons. They incorporate both macro and micro-nutrients and dietary variety in their construction and, therefore, represent an attractive proxy of dietary quality and ultimately of food and nutrition security (Hatløy et al. 2000, Hoddinot and Yohannes 2002, Ruel 2003). Variation of foods across and within food groups is recommended in most dietary guidelines due to a recognition of the need of adequate and balanced nutrient intake to promote nutrition security and health (Arimond and Ruel 2004; Hoddinott and Yohannes 2002). Monotonous diets based mainly on energy dense, caloric, starchy staples that are poor in micro-nutrients are common among food insecure and poor countries. Poor diet variety is more critical for young children and adolescents due to a greater need for nutrient rich food for their health status and correct physical and mental growth (Black et al. 2013). Dietary Diversity Indicators are also relatively cost-effective and can be conveniently introduced in existing surveys. For example, the

Demographic and Health Surveys (DHS) and the World Food Programme's (WFP's) Emergency Food Security Assessments increasingly incorporate dietary diversity modules in their data collection.

These indicators consist of yes/no answer to questions about consumption of food items or food groups over a recent period of time, ranging from 24 hours to two weeks. The most widely used indicators are the Dietary Diversity score (DDS), Food Variety Score (FVS), and the Food Frequency Score (FFS) (Headey and Ecker 2012). While the FVS provides the number of different food items consumed, the DDS consists of a count of different food groups consumed. The FFS incorporates information on frequency of consumption of a specific food over the given time period.

This work uses two sets of dietary diversity indicators, one for each case study. DDS measured at the household level is used for the Mozambique case study. This is based on 12-scale Household Dietary Diversity Score (HDDS) developed by the Food and Nutrition Technical Assistance (FANTA) Project of the United States Agency of International Development (USAID) (Swindale and Bilinsky 2005, 2006). The empirical study based on the dataset from Bangladesh employs FFS, based on a 9-scale Food Consumption Score (FCS) developed by the World Food Programme (WFP).

The section briefly describes the methodology of each dietary diversity indicator used in the MCES validation. The information gathered in the daily expenses module of the Mozambique HCES (IOF 2008-2009) allowed the calculation of the HDDS. The daily expenses module (Appendix AIOF 2008-2009 Questionnaire on the Daily Expenses of the Family Household) includes the number of different food groups purchased in the 24 h preceding the interview, food received in kind[4] and food consumed from family production. A 12 food–group classification as described by Swindale and Blinsky (2005) includes:

[4]Both sections on purchased food and food received in kind include a question on the amount of days a food item are planned for. Although not perfect, thanks to this information the approximate daily quantity of each item is calculated.

Table 4.4 Key food groups of the 12-food group HDDS

Cereals;	Roots and Tubers
Vegetables	Fruits
Meat and Poultry	Eggs
Fish and Seafood	Legumes, nuts and seeds
Milk and dairy products	Oils and fats
Sweets and honey	Miscellaneous (beverages, spices and condiments)

Source: Swindale and Blinsky (2006a)

The survey does not include frequency of consumption, nor the amount of food consumed. In early stages of the analysis, a reduced version of the HDDS was computed. It excluded the last two food groups (sweets/honey and miscellaneous), given the dubious nutritional benefits especially for children. The results however did not differ with the 12-group HDDS and only the full indicators was included in the final description of the results.

The case study on Bangladesh employs the FCS. The Bangladesh Household Food Security and Nutrition Assessment (Appendix A BHFSNA 2008-2009 – Household Questionnaire Section 8, p15) includes the number and frequency of food items consumer in the past week. Food items are then divided into food groups(Table 4.5). Each food group is associated with the frequency or the number of days an item was consumed (from 0: never eaten, to 7: eaten every day). A weight is assigned to each food group, representing its nutritional importance (WFP 2008, p. 20). The final household FCS is obtained by multiplying the weight of each food group (B) by its frequency (A) and then summing the weighted food groups (varying between 0 and 112).

Table 4.5 FCS food groups and weighting system

Food items	Food group	Days eaten in past 7 days, truncated at 7 (A)	Weight (B)	Score (A × B)
Glutinous rice, white rice, maize, cassava, other roots and tubers	Staples	7	2	14
Fish, other aquatic animals, poultry, pork, red meat, wild meat, eggs	Animal protein	2	4	8
Pulses, nuts, bean curd	Pulses	0	3	0
Green leafy vegetables, bamboo, other vegetables	Vegetables	5	1	5
Oil and fats	Oil and fats	2	0.5	1
Fresh fruits	Fruit	2	1	2
Sugar	Sugar	0	0.5	0
Milk and milk products	Dairy products	0	4	0
Composite score				30

Source: Bauman et al. (2013)

There is a rich debate on the appropriateness of the FCS weights. The main guiding principle for such weighting system was based on an interpretation of 'nutrient density' (a term that is used to describe a food group's quality in terms of caloric density, macro and micronutrient and the quantities normally eaten) (WFP 2008).

The comprehensive review by Ruel (2003) provides extensive evidence for consistent and positive relationship between dietary diversity measures and nutrient adequacy[5]. Greater values of dietary diversity are positively correlated with an increment in dietary quality and increased consumption of macro and micronutrients. However, there is mixed evidence of the relationship between dietary diversity and nutrient density[6] of the diets and between dietary diversity and individual nutritional status.

A number of studies have investigated the relationship between dietary diversity and growth in young children, and found a consistent and positive association (Arimond and Ruel 2004; Hatløy et al. 2000; Onyango et al. 1998).Nevertheless, some of these analyses lack appropriate control for socioeconomic factors, which are also highly associated with dietary diversity. More conceptually, there is a lack of consensus on whether dietary diversity indicators should

[5] Nutrient adequacy consists in the achievement of recommended intake of energy and other essential nutrients. It is commonly measured in two ways: the Nutritional Adequacy Ratio (NAR) expresses the ratio between the intake of a particular nutrient and the Recommended Dietary Allowances; and the Mean Adequacy ratio, the sum of the NARs against the number of nutrients that are considered.

[6]Nutrient-dense foods are those foods that provide substantial amounts of vitamins and minerals and relatively few calories. Fruits and vegetables are the nutrient-dense foods, while products containing added sugars, processed cereals, and alcohol are not. (Thompson et al. 2005)

include the choice of single food items rather than food groups. Other sources of controversies include the subjective definition of the weighting system, and lack of agreement on internationally defined cut-off point for signalling high or low dietary diversity (Ruel 2003). A limitation that emerged as a critical factor in this thesis is that dietary diversity indicators are mostly gathered during a single period of the year.This provides only a snapshot of dietary patterns with little information on seasonal variation of food consumption (Savy et al. 2006).

The other group of food security comparator measures used in this study is the experienced based **Self-Assessed Food Insecurity** (SAFI) measures.These measures gather information on respondents evaluation of the depth and the frequency of food insecurity (Headey and Ecker 2012).

They can be as simple as yes/no questions on food affordability over the past 12 months, such as the Gallup World Poll indicators; or include a wider set of questions on various dimensions of a household's food insecurity experience and their frequency, such as the Household Food Insecurity and Access Scale (HFIAS) developed by FANTA project or the Food Insecurity Experience Scale (FIES) developed by FAO.

This class of indicators can provide an additional layer of information on psychological aspects of food insecurity and other dimensions related to anxieties and difficulties in having enough resources to meet basic needs. By deepening the understanding of the food and nutrition security manifestation, they provide additional and valuable layers of information, giving additional insights on the relationship between experiences about food insufficiency and nutritional deprivation.

Often called subjective measures, this information is based on respondents' perceptions of their food security situation. They have been increasingly used to approximate household access to food and provide a more complete picture of the vulnerability of food insecurity (Azzarri 2010). This information is often used in the famine literature to understand household coping-strategies at times of food insecurity and how households respond to seasonality (Devereux 2009). They are appreciated and employed by some researchers and practitioners for their soundness in theory and cost-efficiency (Cafiero et al. 2014, Coates et al. 2006, Webb et al. 2006). Conversely, they are criticized mainly by economists that are wary of response biases and the lack of any common reference frame in subjective questions (Headey and Ecker 2012). Their main criticisms focus on response bias due to question ordering, and lack of cross-sectional comparability across income and education groups and between countries (Headey 2013). For example, on this latter issueDeitchler et al. (2010) argue that terms such as “enough”, “preferred” and “varied” food can be subject to context specific understanding and values creating cross-sectional inconsistencies.

From various growth-monitoring indices and measures that capture physical repercussions of food deprivation, this work employs three **anthropometric measures,** two relative to child and one related to maternal undernutrition. The World Health Organization (WHO) defines acute undernutrition as a weight-for-height z-score (WHZ) below -2, an indication of a recent and severe process of weight loss. A height-for-age z-score (HAZ) below -2 indicates chronic undernutrition typically resulting from recurrent episodes or prolonged periods of nutrition deficiency of calories and/or protein available to the body tissues, or persistent or recurrent ill-health (UNICEF, 1998; Ricci and Becker, 1996). In order to capture the nutritional repercussions of food price fluctuation on adults, maternal acute undernutrition, calculated via the Mid-Upper Arm Circumference (MUAC), is employed. This calculates the circumference of the left upper arm and it is highly correlated with maternal weight and weight for height of non-pregnant women. During pregnancy it is used to screen for risk of low birth weight and perinatal mortality (Krasovec and Anderson, 1991). The standardization method adopted in this thesis follows WHO 2006 guidelines (WHO 2006).

There is a general consensus, especially among nutritionists, on the soundness of anthropometric indicators as they are validated proxies of individual food intake, are considered to be relatively free from measurement errors, and detect both chronic as well as acute manifestations of nutrition security (Deaton and Drèze 2002; de Haen et al. 2011; Headey and Ecker 2012). Their technical soundness makes them good candidates for the purpose of this thesis as they are considered gold standards for nutrition analysis (Fiedler 2008). However, they measure the manifestation of food and nutrition security often at their extreme expression, especially in the case of stunting, that has irreversible effects. This is not to say that they do not offer valuable information, but their widespread use has been criticized on the basis they are unlikely to reveal the process behind the nutritional deprivation.

A significant number of authors have reviewed the advantages and challenges with anthropometric indicators (Svedberg 2011, Nandy and Jaime Miranda 2008). Among the methodological limitations of this class of indicator is that they are systematically derived only for young children and to a limited extent for adult women. However, in order to draw broader conclusions in term of nutritional challenges, intra-household allocation of food and nutrients and discriminating behaviours across gender and age lines, anthropometric indicators should be expanded and include all members of the household. A second type of limitation stems from the fact that anthropometric indices cannot consider whether individuals are minimizing energy expenditure (in terms of physical activity) to minimize constraints on energy intake. In fact, acceptable weight and height can hide strategies to minimize to dietary energy stress.

Beside the literature that attempts at improving the coverage and the current use of anthropometric indicators, a different body of research points at the nature of this class of indicators reflects on the type of dominant discourse they serve and perpetuate. Anthropometric indicators tend to inform specific interventions in order to tackle food and nutrition insecurity, that goes often hand in hand with what is often referred to as 'medicalisation' of nutrition (Robinson 2016). This term frames undernutrition as the result of inadequate nutrient intake and it is closely linked to evidence-based policies and technical interventions in global development. The solution to undernutrition is therefore found in increasing nutrient intake via food fortification[7] and supplementation. Critics of food fortification argue that they were intended as short-term interventions to address ad-hoc child undernutrition crisis in the West[8]. A focus on fortification tends to play into a discourse about food and health that over-medicalise the debate (Sathyamala 2016). Arguably, the proliferation of these interventions comes at the expense of efforts to tackle the underlying causes of malnutrition. What was conceived as the short-term solution, soon became the dominant approach to tackling malnutrition. Gradually agencies stopped talking about the food system and focused on supplementation and fortification as the strategy to solve the nutrition problem (Manson and Margetts 2017).

Indicators of undernutrition provide important information on the various manifestations of undernutrition (acute, chronic or the combination of both). They are particularly valuable for clinicians and humanitarian fieldworkers that operate crisis settings and need to provide immediate responses. However, for planning purposes and broader analysis, it is crucial to

[7]Food fortification is "*the practice of deliberately increasing the content of an essential micronutrient, i.e. vitamins and minerals (including trace elements) in a food, so as to improve the nutritional quality of the food supply and provide a public health benefit with minimal risk to health*" (Allen et al. 2006).

[8]Early examples of food fortification can be found in Switzerland, with Salt Fortification with Iodine introduced in 1920s (Bürgi et al. 1990), and vitamin D enriched milk in the US during the 1930s (Bishai and Nalubola 2002).

know the overarching problems and processes at the root of undernutrition. Anthropometric indicators are the repository of multiple economic, social and biological factors and their interpretation and use requires a thorough understanding of their nature, their limitations and the dominant discourse in which they are operationalised.

4.3 Household Budget Survey identification: selection criteria and surveys' description

This section establishes the criteria and considerations used to identify the case studies and HCES before describing the characteristics of the data sampling strategy used in the empirical analysis. The validation of the MCES is performed by using the following HCES:

- The 2008-09 Mozambique nationally representative HCES (IOF 2008), conducted by the National Institute of Statistics (INE) between September 2008 and August 2009;
- The Bangladesh Household Food Security and Nutrition Assessment conducted between November 2008 and January 2009, a partnership between the WFP, UNICEF and the Institute of Public Health Nutrition, Ministry of Health and Family Welfare, Bangladesh.

A number of considerations were taken for the selection of the specific countries and the identification of the best HCES suited for this exercise. The first consideration is strictly methodological. In order to perform the validation analysis, datasets with a specific range of variables and information were required in order to compute the MCES and dietary diversity scores, self-assessed food insecurity and child anthropometric indices.

Table 4.6 lists the minimum set of variables deemed necessary for the computation of the above mentioned indicators.

Table 4.6. Minimum set of variables and information to derive the indicators and perform the micro-validation of MCES

	Main Predictor	Dependent Variables			Control Variables
	MCES	Household Dietary Diversity Indicators [a]	Anthropometric Indicators (children<5) [b]	Self-Assessed food security information	
Description of variables and information needed	Domestic prices of main staples foods;	Number of unique foods consumed by household members over a given period	Biological sex	Questions on whether the household has experienced food shortage in the past 24h or past month	Demographic characteristics of the household (household size, dependency ratio, etc)
	Monthly household consumption expenditure;	Frequency (in terms of days of consumption over a reference period) that a specific food item or food group is eaten at the	Age (in months)	Questions on when (which month) the household has experienced food shortage	Mother and father or household head characteristics (age, education, employment, marital status)
	Share of each staple food on total staple basket		Weight (in Kg)	Number of meals consumed over a specific reference period (adults and children when possible)	Socio-economic characteristics of the household (land ownership, quality of dwelling, durable good ownership, etc.)
			Height (in cm)		Physical access to dietary diversity (distance to the nearest market, storage availability, etc.)

[a]This indicator category includes both Household Dietary Diversity Scores (HDDS) and Food Consumption Score(FCS).
[b]Following the WHO guidelines (WHO 2006), the three most commonly used anthropometric indices to assess children growth status are weight-for-height, height-for-age and weight-for-age.

In addition to the abovementioned variables, the study seeks to analyse the performance of the MCES in different spatial settings (i.e. rural and urban), and across seasons.

Finally, since the aim of the MCES is to be an indicator that is applicable in a wide range of low income countries with concerning levels of undernutrition, the study compares the MCES performance in Mozambique and Bangladesh. The HCES employed in the empirical analysis were collected between 2008 and 2009. The comparative analysis assesses the performance of the indicator across different agro-climatic conditions, food production systems with diverse cropping patterns and nutritional and health related issues. At the same time, the selection of the survey is driven by considerations related to the minimum set of above mentioned criteria. Mozambique and Bangladesh typify the socio-economic and nutritional problems that the study is interested in capturing and where the MCES can be potentially operationalized.[9]

Before moving to the description of the study design of the above mentioned surveys, this section engages with some of the considerations that emerged in selecting the level of the MCES validation and empirical strategy. There is a general concern among various analysts in using surveys that are collected at the household level for nutrition analysis purposes. Most of the hesitation stems from methodological considerations. For example, nutritionists raise

[9]A brief country profile is provided before the empirical analysis (Sections 5.1 and 6.1)

several concerns in adopting household level data on food acquisition and consumption as a proxy for food intake data.

Household Consumption Expenditure Surveys normally register food purchase or acquisition, information that cannot be directly translated into actual food or nutrient intake. This is due to lack of information on intra-household distribution of food, food preparation and waste (Fiedler et al. 2013). Uncertainties in using HCES in analysing nutrition originate from the "*heterogeneity in the design and implementation of such surveys and a general lack of analytic juxtaposition of directly comparable individual level data using HCES*" (Fiedler 2013, p.58). However household level surveys offer a valuable opportunity to use existing data sources to address gaps, with available information, on food and nutrition (Imhoff-Kunsch et al. 2012, Fiedler et al. 2008). HCES are experiencing a significant expansion with larger numbers of low and middle income countries being represented. Therefore, despite the limitations, HCES offer opportunities in channelling resources in a cost-effective way and minimising the duplication of similar surveys. Using HCES in this setting also builds upon a dialogue across disciplines that can help with standardization and harmonization of methodological approaches, terminology and measurement.

The remainder of this section provides a description of the study designs of the Mozambique HCES (*Inquérito sobre Orçamento Familiar 2008-2009, referred to hereafter as IOF2008*) and the Bangladesh HCES (*The Bangladesh Household Food Security and Nutrition Assessment 2008-2009*).

Inquérito sobre Orçamento Familiar 2008-2009[10]

IOF2008 is a nationally representative household budget survey, conducted by the National Institute of Statistics (INE) of Mozambique. The survey covers the period between September 2008 and August 2009 and gathered information on household demography, education, health, employment, housing and other poverty indicators. In total, 10832 households were randomly selected and interviewed: 5609 resided in rural areas and 5223 in urban areas. This sample is representative for the whole of Mozambique and each of the ten provinces plus Maputo City. (Table4.7 illustrates sampling design of IOF 2008).

Table4.7 IOF 2008-2009 Sample Design.

[10] The full Questionnaire can be viewed in Appendix A

Provinces	Primary Sampling Units	Number selected Households	Number interviewed Households
Total	**1060**	**10848**	**10832**
Niassa	80	816	814
Cabo Delgado	80	780	780
Nampula	160	1584	1575
Zambézia	160	1524	1523
Tete	80	768	768
Manica	80	804	804
Sofala	80	852	851
Inhambane	80	804	803
Gaza	80	816	815
Maputo Província	80	900	900
Maputo Cidade	100	1200	1199

Source: IOF 2008-2009

For each household, interviews were conducted over a one-week period, recording information on general household characteristics, daily expenses and own consumption, possession of durable goods, gifts and transfers received, and lower frequency expenses (such as school fees or purchases of clothing).

The Daily Expenses questionnaire recorded data on food consumed. Most commonly purchased food items were pre-coded but the questionnaire was open-ended to include not listed food items. Households were interviewed three times over a seven-day period. On the first visit households would be asked about food acquisition during the previous day; three sets of questions on quantity, value, unit and source of (i) purchased foods, (ii) foods derived from own production and (iii) food received as transfers (gifts) or received from work. During the second and third visits households would be asked what they had purchased on the day of the interview and during the previous two days. The questionnaire does not record actual food consumed or intra-household allocation of food and all estimates are based on total household consumption.

The survey included a Household Questionnaire (Appendix A) that gathered information on family structure, household members' education, health, employment, agricultural and animal husbandry activities, housing characteristics and conditions. It also recorded information on shocks in the preceding past 5 years, poverty indicators, banking and monetary conditions and concluded with the physical measurement of children under five years of age.

Finally, IOF 2008-2009collected a set of information at the community level (Community Questionnaire in Appendix A) that included sections on: community demography, economic activities and infrastructure status, existence of education and health facilities, state of social action (i.e. presence of community radio and TV stations), presence of agricultural infrastructure and facilities and local market food prices.

Data collection was conducted over the period of one year, starting in September 2008 and ending in August 2009. The survey period is divided into four quarters and during each quarter one fourth of the households that the surveys is designed to represent are interviewed.

The Bangladesh Household Food Security and Nutrition Assessment 2008-2009

The Bangladesh Household Food Security and Nutrition Assessment (BHFSNA)[11] was conducted between November 2008 and January 2009[12] and collected in order to provide a better understanding of the impact of the 2007-2008 food price changes on food insecurity of households in Bangladesh (WFP et al. 2009).

The survey consisted of three questionnaires: 1) a household questionnaire included questions on household composition, socio-economic status, economic activity, education, food expenditure, livelihood strategies, overall health status, water and sanitation; 2) a nutrition and health questionnaire included child and mothers anthropometric measures, infant and young child feeding practices, infectious diseases and mortality and access to health services; and, 3) a trader questionnaire that gathered price information on products, price variation over time, selling volumes and their variations, product sources and trading information.

Data was collected between 11th November 2008 and 19th January 2009, a period that corresponds with the *aman* harvest season. The survey is nationally representative and includes 10378 households over six divisions in the country (Barisal, Chittagong, Dhaka, Khulna, Rajshahi, Sylhet) including both rural and urban areas[13]. The trader questionnaire surveyed 180 markets and interviewed 900 traders. The nutritional status module included the measurement of the Mid-Upper Arm Circumference (MUAC) for 3868 female components of the household that where either mothers or pregnant and MUAC, weight, height and oedema of 4175 children aged 0 to 59 months. Unfortunately, due to the relatively short time frame of the survey, the seasonal dimension of food security and vulnerability cannot be fully analysed.

4.4 Methodological approaches

The MCES validation evaluates the association between the MCES and the comparator measures using the following methodological approaches: (i) analysis of the Pearson and

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[11]The full Questionnaire can be viewed in Appendix A

[12]The assessment was a conducted in a partnership between the WFP, UNICEF and the Institute of Public Health Nutrition, Ministry of Health and Family Welfare, Bangladesh.

[13]A map with the areas in which the interviews were conducted can be found in the Appendix C

Spearman correlation coefficients between the MCES and the selected comparator measures on food and nutrition security; (ii) econometric assessment of the association between the MCES and comparator measures using a range of estimators.

The following section describes each method used in the validation. It firstly defines the computation method and interpretation of correlation coefficients and then it describes the rationale and model specification for count model data, ordered logistic models and ordinary least squares models.

- *Correlation analysis*

Correlation analysis measures the direction and strength of the linear relationship between two quantitative variables. There is no assumption of causality and it is performed in order to explore possible associations between the MCES and the food and nutrition security comparator measures. Correlation matrices are helpful starters in data analysis and can provide a preliminary sense of the relationship between data. They also provide a further technique to check the robustness of the results in addition to regression analysis (Hoddinott and Yohannes 2002, Maxwel et al. 1999).

- *Count data model*

Poisson log-linear models for count data are employed to study the possible effects of the variation of the MCES on HDDS, where the latter is treated as the dependent variable. The HDDS is considered a count variable (exhibiting a number of possible outcomes) and a negative relation between the dietary diversity indicator and the MCES is expected.

Classical linear regression models provide biased results when modelling a discrete variable denoting the number of occurrences of an event (such as the number of food groups consumed by the household that takes only non-negative integer values). This is because these variables take a small number of values with strictly positive probabilities, making the assumption of normality of the disturbances invalid (Cameron and Trivedi 2013, Gourieroux et al. 1984).

A number of recent studies have used discrete probability distributions to analyse dietary diversity scores (DDS) (Hirvonen 2016, Sibathu et al. 2015, Snapp and Fisher 2014). The Poisson regression predicts the probability of an independent event occurring in a given time period and relates this probability to a vector of regressors (Sibathu et al. 2015).

In the basic Poisson model, the probability of observing Y_h possible outcome of HDDS for the h_{th} household is given by:

Equation 4.1

$$Prob\ (Y_h) = \frac{e^{-\lambda h}\lambda^{Yh}}{Yh!}$$

Where λ^{Yh} is the Poisson parameter, denoting the expected value of Y. The Poisson distribution is a non-linear regression model whose parameters are estimated through maximum likelihood methods or by using a log likelihood function. The fundamental assumption of the Poisson model is that the mean of the outcome variable $Yij$is equal to its variance. Thus,

Equation 4.2

$$\lambda_{ij} = E(Y_{ij}) = Var(Y_{ij}) = e^{X'ij\beta}$$

The X in Equation 4.2 denotes exogenous variables correlated with the outcome variable Y_h and β represent the unknown parameters. Taking the logarithm of both sides of the equation we get:

Equation 4.3

$$\boldsymbol{ln\lambda_{ij} = \alpha_0 + \beta X_{ij}}$$

Therefore the Poisson model sets:

Equation 4.4

$$E[y_i|\mathrm{x_i}] = \lambda_i = \exp(x_i'\beta) = \exp(\beta_1 + \beta_2 x_{2i} + \cdots \beta_k x_{ki})$$

The interpretation of the coefficients is different from that in the OLS models. A one unit change in the regressor leads to a change in the conditional mean by the amount $E[y_i|x_i]x\ \beta$. Another way of saying this is that a one unit change of the regressor leads to a proportionate change in $E[y_i|\mathrm{x_i}]$ of*β*.

Equation 4.5 represents the extended model specification, where the dependent variable is the Household Dietary Diversity Scores (HDDS):

Equation 4.5

$$\mathrm{Log}(E[HDDS_i|\mathrm{x_i}]) = \alpha + \beta_1 MCES_i + \beta_2 \boldsymbol{P} + \beta_3 \boldsymbol{HH} + \beta_4 \boldsymbol{PA} + \beta_5 \boldsymbol{s} + \beta_6 \boldsymbol{L} + \boldsymbol{\varepsilon}$$

Where $HDDS_i$and $MCES_i$ are the HDDS and MCES of the i_{th} household. The main parameter of interest in Equation 4.5 is β_1, the estimate coefficient associated with the MCES, while the remaining are the control variables. $\boldsymbol{P}$to $\boldsymbol{L}$ are vectors of control variables common to both SAFI and HDDS models, that will be discussed separately for each case study in Chapter 5 and

6.Appendix Dillustrates the Poisson distribution justification for the HDDS (used in the Mozambique case study).

- *Ordered logistic model*

The study of the relationship between the MCES and Self-Assessed Food Inadequacy measure (SAFI) employs ordered logistic models for the estimation strategy. The two SAFI indicators are expressed as ordinal variables that represent:

(i) *Number of meals* eaten (by the household or adults and children respectively) the day preceding the interview (0-3 and 0-7), and

(ii) Household Food sufficiency during the month before the interview (exhibiting three possible outcomes: 1:insufficient, 2:sufficient, 3: more than sufficient).

A negative association between SAFI measures and MCES is expected, suggesting that increases of the food price indicator can negatively affect the number of meals eaten as well as food sufficiency experienced in the household.

In contrast to other types of linear regression, ordered logistic regression uses a latent continuous variable y^* as a linear combination of independent variables,x, and a disturbance term with a standard Normal distribution (Jackman 2000).

Equation 4.6

$$y^* = x_i\beta + e_i, \qquad e_i \sim N(0.1), \forall i = 1, \dots, N$$

y_i, the observed ordinal variable can take on values from 0 to *m* such as

Equation 4.7

$$y_i = j \ <=> \mu_{j-1} < y_i^* \leq \mu_j$$

Where $j = 0, \dots, m$(Jackman 2000).

The changes in the dependent variables are translated into the probability of observing a particular outcome of the ordinal variable. These probabilities are classified in the form of ordinal ranking:

Equation 4.8

$$\begin{aligned} \Pr[\, y_i = 0] &= P[\mu_{-1} < y_i^* \leq \mu_0 \\ &= P[-\infty < y_i^* \leq \mu_0] \\ &= P[y_i^* \leq \mu_0] \end{aligned}$$

Where the μ_is are the thresholds or cut-off points of the categories. The threshold values are parameters to be estimated from the data. By substituting the ordinal ranking it is possible to obtain the probabilities of each ordinal outcome:

Equation 4.9

$$\Pr(y_i = j) = \Phi(\mu_j - x_i\beta) - (\mu_{j-1} - x_i\beta)$$

The coefficient in an ordinary logistic regression is expressed in odds ratio. Odds ratios are defined as the ratio of the probability that an event will occur divided by the probability that an event will not occur:

$$\frac{odds\ (\text{if the corresponding variable is incremented by 1})}{odds\ (\text{if variable not incremented})}$$

Equivalently

$$\frac{P(event|x+1)/(1-P(event|x+1))}{P(event|x)/(1-P(event|x))}$$

The empirical model used to assess the relationship between SAFIs and MCES consists oftwo ordered logistic models as shown in Equation 4.10:

Equation 4.10

$$Ln\ Pr(SAFI_j = i) = ln\ \alpha + \beta_1 MCES_h + \beta_2 \boldsymbol{P} + \beta_3 \boldsymbol{HH} + \beta_4 \boldsymbol{PA} + \beta_5 \boldsymbol{s} + \beta_6 \boldsymbol{L} + \boldsymbol{\varepsilon}$$

Where $Pr(SAFI_j = i)$ refers to the probability of a specific outcome of one of the SAFI indicators of the *j*th household.

- *Ordinary Least Squares*

Drawing from Tiwari and Zaman (2013), the

Equation 4.122 and Equation 4.13:

Equation 4.11

$$WHZ_{ih} = \alpha + \beta_1 MCES_h + \beta_2 \boldsymbol{P} + \beta_3 \boldsymbol{M} + \beta_4 \boldsymbol{C} + \beta_5 \boldsymbol{HH} + \beta_6 \boldsymbol{WS} + \beta_7 \boldsymbol{s} + \beta_8 \boldsymbol{L} + \boldsymbol{\varepsilon}$$

Equation 4.12

$$HAZ_{ih} = \alpha + \beta_1 MCES_h + \beta_2 \boldsymbol{P} + \beta_3 \boldsymbol{M} + \beta_4 \boldsymbol{C} + \beta_5 \boldsymbol{HH} + \beta_6 \boldsymbol{WS} + \beta_7 \boldsymbol{s} + \beta_8 \boldsymbol{L} + \boldsymbol{\varepsilon}$$

Equation 4.13

$$MUAC_{ih} = \alpha + \beta_1 MCES_h + \beta_2 \boldsymbol{P} + \beta_3 \boldsymbol{M} + \beta_4 \boldsymbol{HH} + \beta_5 \boldsymbol{WS} + \beta_6 \boldsymbol{s} + \beta_7 \boldsymbol{L} + \boldsymbol{\varepsilon}$$

Where $WHZ_{ih}$and HAZ_{ih} are weight-for-height z-scores and height-for-age z-scores of the i_{th} children under 5 living in the h_{th}household and$MUAC_{ih}$is the mid-upper arm circumference of the i_{th} mother of the h_{th} household.

Drawing from Brinkman et al. (2010) and D'Souza and Jolliffe (2013a, 2013b) the association between the FCS (the food frequency score available for the Bangladesh case study) and the MCES is analysed via the following OLS regression (Equation4.14):

Equation4.14

$$FCS_h = \alpha + \beta_1 MCES_h + \beta_2 \boldsymbol{P} + \beta_3 \boldsymbol{HH} + \beta_4 \boldsymbol{PA} + \beta_5 \boldsymbol{L} + \boldsymbol{\varepsilon}$$

Where FCS_{ih} represents the FCS of the h_{th}household and treated as a continuous variable. Similarly, to the previous models, the control variables are discussed separately for each case study in Chapter 4 and 5. The different empirical approaches are shaped around the dependant variables and allow the use of interaction terms to explore the effect of seasonality and income distribution.

4.4.1 Robustness Checks

The robustness check for the MCES represents an important part of the empirical analysis. Ultimately, the research aims at evaluating whether the MCES is a viable alternative to individual food prices in the area of food and security analysis. Therefore, robustness checks are performed by assessing whether using individual staple food prices produce equally good or better results (in statistical terms). Three approaches are selected to evaluate the efficiency and validity of the statistical results from the models. First, Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC)are calculated to assess the quality of models. This is followed by a set of F-tests for nested models investigating whether the inclusion of the MCES to a food price model is to be preferred to the simpler model excluding the index. Finally, this section also discusses a sensitivity and specificity analysis. The section presents the chosen strategies individually.

Akaike Information Criteria and the Bayesian Information Criteria

The first set of robustness checks comprises Akaike Information Criteria (AIC) and the Bayesian Information Criteria (BIC). AIC calculation selects the model that minimizes the negative likelihood penalized by the number of parameters as specified in the validation equations (Akaike 1973). As noted in Section 4.4, the validation equations are specified in Equations 4.5 and Equations 4.10 - 4.14. AIC is defined as:

Equation 4.15

$$AIC_\pi = -2\log(L_\pi) + 2k$$

where π indicates a fitted model, $L_\pi$refers to the likelihood under the fitted model (π) and k refers to the number of parameters in each of the validation models. Specifically, AIC is aimed at finding the best approximating model to the unknown true data generating process (Akaike, 1973; Bozdogan, 1987; Zucchini, 2000). AIC is evaluated for each of the validation equations (Equations 4.5 and 4.10 to 4.14) for a set of competing indicators (i.e using MCES and individual staple food prices). The model associated with the smallest value of AIC is selected as the best-fitting model.

Following Akaike's lead, a number of alternative information criteria have been developed. The Bayesian Information Criterion (BIC) proposed by Schwarz (1978) is perhaps the mostly used. It is derived within a Bayesian framework as an estimate of the Bayes factor for two competing models, and it is defined as follows:

Equation 4.16

$$BIC = -2\log(L) + plog\ (n)$$

Similarly, L refers to the likelihood under the fitted model, p denotes the number of parameters in each validation model and n is the sample size. Models that minimize the Bayesian Information Criteria are selected, and from a Bayesian perspective, BIC is designed to find the most probable model given the data. As in AIC, the model corresponding to the smallest BIC value will be chosen as the most appropriate one.

Using the same model specification used in the validation section for each set of food and nutrition security comparator measure, AIC and BIC are computed for two sets of alternative indicators: (1) the MCES; (2) individual staple food prices (which are the same staple foods included in the MCES numerator).

F-test for nested models comparison

The F-test for nested models is used to test a reduced model (one with only individual food prices) against the full model (one reduced model plus the MCES). The F-test shows whether the additional term (MCES) is significantly improving the overall explanatory power of the model or just adding unnecessary complexity to it.

The robustness check uses this method to compare two models:

Equation 4.17

$$y = \beta_0 + \beta_1 FoodPrices + \beta_2 HHExpenditure + \varepsilon$$

Equation 4.18

$$y = \beta_0 + \beta_1 FoodPrices + \beta_2 HHExpenditure + \beta_3 MCES + \varepsilon$$

Where *y* refers to the comparator measure of food and nutrition security that is used to validate the MCES, *FoodPrices* are the individual food prices that are used to compute the numerator of the MCES, *HHExpenditure* denotes the total household consumption expenditure used as the denominator of the MCES and finally, the MCES.

The model specified in Equation 4.17 is the restricted model and the one specified in Equation 4.18 is the full model. Equation 4.17 is nested within Equation 4.18. Two models are nested if both include the same terms, belong to the same dataset and one has at least one additional term.

The objective is to assess whether the second equation (i.e. the one comprising the MCES) contributes additional information on the association between each dependent variable and the predictors.

The F-test consists in a comparison of the sum of squares residuals (SSR) for Equation 4.17 (SSR1) and Equation 4.18 (SSR2).

The F-ratio is specified as follows:

Equation 4.19

$$\mathrm{F-test} = \frac{(\mathrm{SSR1} - \mathrm{SSR2})/\mathrm{q}}{\mathrm{SSR2}/(\mathrm{n} - \mathrm{k} + 1))}$$

Where *n* is the number of observations, *k* refers to the number of the parameters of Equation 4.17 and *q* the number of restrictions (namely the number of coefficients being jointly tested).

Sensitivity and Specificity analysis

An additional robustness check of the MCES against the comparator measures of food and nutrition security is performed via sensitivity and specificity analysis after performing a logistic regression. This is an intuitively appealing way to assess the “fit” of a logistic regression model. Logistic models seek to predict an event, which either takes place (positive outcome) or does not (negative outcome). The model can then predict a positive or negative outcome, which can be “verified” by looking at the actual observed outcome, determining four possible scenarios: a true positive outcome is predicted, a false positive outcome is predicted (the outcome did not realise, but the model predicts it did, a false positive), a true negative outcome is predicted, or a false negative outcome is predicted (the outcome did realise, but the model predicts it didn’t). The sum of true positive (sensitivity of the model) and true negatives (specificity of the model) is defined as the quantity of correctly classified cases for a binary dependent variable model. It should be noted that the output of a logistic regression is not a classification as positive or negative, but a predicted probability of being positive or negative.

Stata command *estat classification* is used to obtain classification tables of sensitivities and specificities. In Stata, estat class uses a default probability of 0.5. Classification tables assess how many of the dependent variables’ observed values (1 or 0) have been correctly predicted.

As the estimation employs a mixture of continuous, ordinal and dichotomous variables, the following steps are carried out to obtain binary indicators for each of the models. First, all alternative indicators against which the MCES is tested in the micro-validation exercise, are modelled as dichotomous dependent variables[14]. Secondly, the *naïve estimate* is defined as the probability of being food insecure (value of the comparator measures equal to 1), without the introduction of the MCES in the model. Thirdly, five logistic regression models are estimated (between each comparator measure) where the MCES is introduced as a covariate. Then, the classification table is estimated. Finally, the values of the naïve hypothesis are compared and analysed against the correctly classified ones as an indication that the inclusion of the MCES in the model improves (or does not improve) the capacity of the regressions to identify food secure and food insecure households and individuals.
Chapter 4 and 5 individually report robustness checks after the presentation and discussion of the results.

4.5 Reflections of interdisciplinary approaches

In recent years, approaching complex problems across disciplines and between different stakeholders (experts, policy makers, practitioners and the public) has become widely accepted(Eigenbrode 2007, Klein 2004, in Lélé and Norgaard 2005). However, this exercise does not come without its opportunity costs given the lack of prefabricated or well established solutions. Most importantly, despite the call for more interdisciplinary work, disciplines are reluctant to collaborate and engage in dialogues across boundaries. Disciplines are often formed by rigid theoretical frameworks, jargon and methodologies. Integration with the elements of other bodies of knowledge is often seen as a threat to their own primacy. Disciplines are indeed characterized by their own peculiar *disciplinary cultures that* often view each other in an antagonistic manner (Schoenberger 2001).

Working across economics and nutrition does not represent insurmoutablechallenges, as they both agree in the quantifiable methods and both disciplines have demonstrated various degrees of openness towards their respective methodologies. This work acknowledges the constraints of interdisciplinary research and values the opportunity of interdisciplinary work. Interdisciplinarity offers the space for dialogue among researchers and the opportunity to

[14] Different threshold points are used to create dichotomous variables and will be discussed in each empirical chapter.

access a wider range of theories and methods. However, this thesis is also aware of the hierarchical ranking and power relation between disciplines, with mainstream branches of economics expressing *disciplinary imperialism* towards less quantifiable disciplines in social science (Schoenberger 2001: 374).

This work, while using tools and methods from empirical economics, is not grounded in the belief that economic models are the bestor onlytools to explain complex interaction between food prices, real incomes and food and nutrition security. Notably, food and nutrition security is a process that develops in a continuum. Rigorous assessment necessitates a suite of indicators and in depth assessments that are respectful of context specific factors and willing to investigate and unveil the complex underlying causes of poverty, injustice and food and nutrition insecurity. This is possible by incorporating different disciplines in such effort that cross-pollinate their mutual understanding of the problem, helping to design common solutions.

4.6. Ethical concerns and conclusions

The nature and topic of the secondary data sources used in the analysis do not pose ethical concerns in terms of identity disclosure or management of sensitive data. The empirical work uses already anonymized data sources with the agreement of the institutions that shared the datasets (UNU-WIDER and WFP). The author is grateful for the generosity of both institutions.

Chapter 4 introduces the rationale, data and methodologies used to validate the MCES before the validation estimates are presented in Chapter 5 and 6. This chapter completes the methodological aspect of the thesis that includes two sets of methodological approaches: one set of methodological considerations and approaches for the computation of the MCES and another (wider) set for its validation.

The MCES validation exercise stems from the need to assess its usefulness as an effective measure of the effects of price changes on food and nutrition security and tackles some of the shortcomings of individual staple food prices (illustrated in Chapter 2). The validation exercise employs three sets of comparator measures: dietary diversity scores, self-assessed food insecurity measures and anthropometric indicators. It applies household level analysis using two case studies, Mozambique and Bangladesh (between 2008 and 2009) in order to assess the MCES ability to gauge food and nutrition security impacts of food price fluctuations over two different contexts.

Two sets of empirical strategies assess the association between the MCES and selected food and nutrition security comparator measures. The first stage is represented by an exploratory stage that uses correlation coefficients to determine the direction of the association between the variable of interest. Secondly, a set of econometric evaluations are implemented that control for confounding factors and allow the introduction of interaction terms with seasonality and income dimension. The methodological section concludes with presenting the strategies adopted to test the robustness of the MCES against individual staple food prices.

Finally, reflections matured during this research on the nature and meaning of interdisciplinary work are described where the difficulties and the absence of ready to use methods and approaches are discussed.

In the following chapters the empirical analysis that uses the two case studies of Bangladesh and Mozambique during the 2008-09 food price crises are presented. The two empirical analyses are treated separately in two twin chapters that follow a similar structure. They provide a brief country description and an overview of the 2008-2009 food price crisis in the country before engaging in the data description, exposition of results and discussion.

Chapter 5 MCES validation 1 - Estimates for Mozambique

Introduction

Chapter 5 and 6 are two *twin* chapters that discuss the estimates of the MCES validation for two case studies. They follow similar structures and will guide the reader from the discussion of general aspects of the countries that have been selected to more specific issues related to the validation exercise.

Chapter 5 is organized as follows: a brief country profile introduces the reader to the Mozambican context, in particular with its economy, crop production system, and recent trends in poverty, food security and undernutrition (5.1). The general context section terminates with describing the food riots exploded during the 2008-09 food price crises where the reader will encounter, for the first time in this thesis, anecdotal records and popular discourses (5.2). This documentation is included to contextualise and provide more depth to the analysis. Subsequently, the section will move on to the description of the data (5.3), and findings of the MCES validation (5.4). Before concluding, Section 5.5 presents the estimates of the robustness checks.

5.1 Country profile – Agriculture and Nutrition in Mozambique

The Republic of Mozambique is a resource-rich state that lies on the eastern coast of Southern Africa (Figure 5.1). Despite recently experienced economic growth[1], Mozambique remains one of the poorest countries in the world, with a Human Development Index score of 0.416, making Mozambique the 180th of 188 countries (UNDP 2015).

[1] In 2014 real GDP grew by 7.6% and this trend is expected to remain strong throughout 2016 (UNDP 2015).

Figure 5.1 Political Map of Mozambique

Source: DHS, 2011a

Moreover, poverty statistics show a mixed picture (Cunguara and Hanlon 2010). On one hand there is a story of success with officials and international agencies tend to consider Mozambique as one of the success stories of contemporary Africa (World Bank (2015) data show a decline in the poverty headcount ratio from 69.4% in 1996 to 54.1% in 2002)[2]. In addition, in the past ten years, the country has witnessed economic growth thanks to investments in *mega-projects* (Do Rosario 2012, p.3) in the extraction sector[3] that accounts for *circa* 70% of the Mozambican gross industrial production (Do Rosario 2012).

Despite these figures, a number of studies indicate increasing levels of inequality throughout the country (Do Rosario 2012, Mosca 2011, Cunguara and Hanlon 2010)[4] reflecting the difficulties in translating economic growth into an equal distribution across wealth groups (Wuyts 2011).

Agriculture is the predominant economic activity and 70% of the Mozambican population resides in rural areas (Donovan and Tostão 2010, Hanlon 2010). Between 2007 and 2015, on average, agriculture contributed to Mozambique's GDP 4.53% of its total value (Table 5.1). The abundance of arable land has attracted over the years investors from South Africa and Zimbabwe, particularly interested in cash crops directed to the export sector (sugar, cotton, tobacco, tea, copra, fruit, sisal, cashew) (OECD, 2013).

[2] However, progress stalled in more recent years and poverty headcount ratio increased to 54.7% in 2008 (Brooks 2017).

[3] In particular, Do Rosario (2012) mentions three investments in large scale projects: Mozal in aluminium extraction, SASOL (South Africa) in oil and Moma in heavy sands projects.

[4] Cunguara and Hanlon (2010) suggest that poverty data are susceptible to the methodology and assumptions with which poverty lines are constructed.

Table .5.1 Performance of agriculture in the economy of Mozambique

	2007	2008	2009	2010	2011	2012	2013	2014	2015
Agriculture, value added (annual % growth)	8.45	6.99	5.15	5.16	4.15	1.98	1.89	3.73	3.23

Source: World Development Indicators (2016) - accessed 20 December 2016

However, the reality of the agricultural sector is one heavily dominated by peasant family farming, characterized by a high dependence on climatic factors, very limited access to inputs, and lack of infrastructure, commercial networks, and financing (OECD, 2013). These characteristics have hindered comprehensive foreign and domestic investment in the agricultural and agro-industry sector, with limited development of infrastructure and markets (OECD 2013). Although Mozambique produces most of its domestic food supply, the country remains a net importer of agricultural products (Table 5.2).

Table5.2 Performance of agricultural trade in Mozambique

	2003	2005	2007	2009	2011	2013
Import Dependency Ratio (%)	7.88	11.03	8.74	9.64	6.34	7.16
Net exports (NX)*	-927	-1204	-888	-1204	-922	-1149

* Unit: 1000 tons

Source: FAOSTAT - accessed 20 December 2016

Crop production represents 78% of total agricultural GDP[5] with the main food crops being cassava, maize, sweet potato, rice, sorghum, millet and pulses (Benson et al. 2014). Together, these crops account for 90% of the total crop production. The remainder 10% is represented by cash crops, mainly produced for the export sector (Benson 2014).

Substantial agro-ecological variability means significant discrepancies in terms of agricultural production throughout the country (Benson et al. 2014, Do Rosario 2012). The northern and central regions are the main maize production areas, which is central in Mozambican diets and economy. Production from the north supplies the main cities of northern Mozambique and a part is exported to Malawi. Maize cropped in the central regions supplies the capital, Maputo (Donovan, 2011). Other cereals such as wheat and rice play a minor role. Wheat is predominately imported and rice production is primarily intended for home consumption (Donovan, 2011). With 80% of the national workforce being employed in agriculture

[5] Other agricultural sub-sectors include livestock, fisheries and forestry that contribute 6%, 7% and 9% respectively to the agriculture GDP (Benson et al 2014).

(characterized mainly by smallholder farming families operating on a plot of 1.1 ha), the lack of public and private investment in this sector, which could have created rural jobs and generated revenue, is a missed opportunity for poverty reduction strategies (Do Rosario 2012).

Widespread poverty is accompanied by high national levels of childhood under-nutrition raising several concerns. Compared to child undernutrition status in neighbouring countries in Eastern and Southern Africa (Table 5.3), Mozambique appears among the countries with the highest percentage of undernourished children under five. The country also reports the highest prevalence of child underweight in the region, the second highest for wasting prevalence and third highest for stunting prevalence.

Table 5.3 Comparison of national child nutrition indicators in the region

Country	Survey Year	Underweight %	Stunting %	Wasting %
Kenya	2008/2009	n.a.	35.3	5.2
Malawi	2010	12.8	47.1	4.0
Mozambique	**2008/2009**	**17.4**	**42.9**	**6.8**
Tanzania	2010	15.8	42.0	4.8
Zambia	2007	n.a.	45.4	6.7
Zimbabwe	2005/2006	5.8	28.1	15.8

Source: DHS: 2007, 2009, 2010, 2011a, 2011b, 2011c.

The prevalence of child stunting in Mozambique of 43% (in 2011) showed no improvements between 2003 to 2011 and the prevalence of wasting doubled from 4% in 2003 and 2008 to 8% in 2011 (Table 5.4). The prevalence of stunting and wasting are consistently lower in urban than in rural areas (last panel of Table 5.4). Furthermore, chronic malnutrition measures show virtually no change between 2003 and 2011 in both urban areas (where is fell from 37% to 35% respectively) and rural areas (swinging marginally between 46% and 47% during the same period) (Table 5.4).

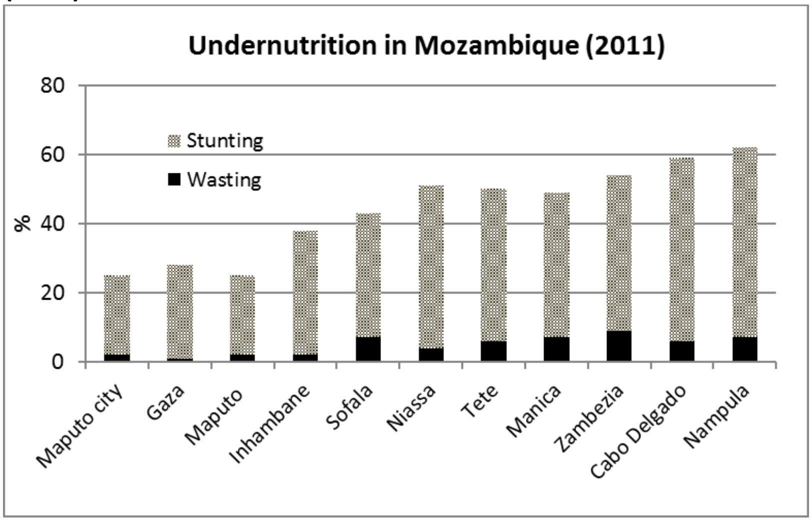
Table 5.4 Trends in child undernourishment in Mozambique between 2003, 2008 and 2011

	Prevalence of chronic undernutrition (%)			Prevalence of acute undernutrition (%)		
Survey type and date						
DHS (2003)	41			4		
MICS (2008)	43			4		
DHS (2011)	43			8		
Area of Residence						
	2003	2008	2011	2003	2008	2011
Urban	37	35	35	4	3	4
Rural	46	47	46	4	5	7

Source: DHS (2003, 2011) and MICS (2008)

Diversity in the distribution of undernutrition is observed across the provinces: Southern areas shows lower levels of malnutrition (eg. Maputo and Maputo province exhibiting a prevalence of 23% of stunting and 2% of wasting) compared to Northern provinces, where Nampula and Cabo Delgado exhibit figures as high as 55% and 53%, respectively, in the prevalence of stunting (Figure 5.2). Prevalence of wasting exhibits a similar dichotomy with the central regions (with the exception of Nampula) having the highest percentages of child wasting: Zambezia reports the highest prevalence of wasting at the national level (9%) followed by Manica and Sofala (7%).

Figure 5.2 Trends of prevalence of wasting and stunting in the provinces of Mozambique (2011)



Source: DHS 2011a

5.2 Food prices and bread riots in Mozambique

Bread riots (Marshall 2016) sparked off throughout the country when, at the beginning of 2008, the prices of basic goods (particularly fuel and food) increased by more than 50% or more over a few months. The government failed to implement measures to buffer the pass through of international fuel and agricultural prices to Mozambican domestic markets (Arndt et al. 2008), causing anger and widespread discontent throughout the country.

Table 5.5 compares average retails prices of food and fuel between July 2005 and July 2008. Prices of gasoline, diesel and kerosene increased by 53%, 30% and 74%, respectively, between 2006 and 2008. Staple food prices, such as rice, maize, and wheat witnessed a dramatic rise, with the latter reaching unprecedented levels (with almost 108% increase between 2006 and 2008).

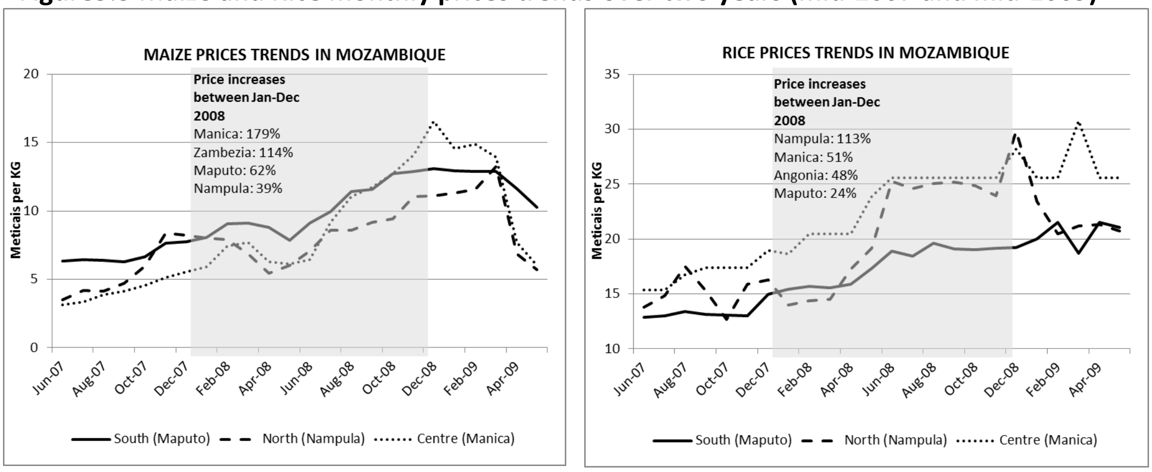
Table 5.5 Changes in domestic retail prices in Mozambique

	July 2005	July 2006	July 2007	July 2008	Change, 2006-08 (%)
Average retail price in Maputo					
Rice (Meticais/kg)	9.3	11.4	14.5	19.3	68.8
Maize (Meticais/kg)	5.9	6.5	6.4	10.2	57.0
Wheat flour (Meticais/kg)	11.0	11.8	15.5	24.5	107.6
Gasoline (Meticais/liter)	-	27.2	33.7	41.6	52.9
Diesel (Meticais/liter)	-	27.2	27.5	35.4	29.9
Kerosene (Meticais/liter)	-	16.5	20.3	28.7	74.1

Information is derived by multiple data sources: Development Economics Prospects Group (World Bank); Weekly Agriculture Market Bulletin (Ministry of Agriculture, Mozambique); Ministry of Energy, Mozambique. Source: Arndt et al. 2008 (p. 498).

Figure 5.3 illustrates the evolution of maize and rice prices between mid-2007 and mi-2009 in the north, centre and south of Mozambique. In mid-2008 basic food prices had reached their peak after a long period or relatively low food prices. The sharp increase of food prices coincided with the main harvest season (May and June) that in 2008 resulted to be less favourable than in previous years (Arndt et al. 2016). This resulted in a sharp increase of basic food products prices that peaked between September 2008 and February 2009, before starting to decline in early 2009, but with significant regional differences. While maize prices in the north and the centre eased at the beginning of 2009, the southern regions experienced a slower descending trend.

Figure5.3 Maize and Rice monthly prices trends over two years (mid-2007 and mid-2009)*



* Monthly price trends of only three Mozambican provinces are included for matter of clarity. Maputo is representative of staple prices of the south regions, Nampula of the north, and Manica of central regions.

Sources: Author, using FAO Food Price Monitoring and Analysis Tool – accessed 15 May 2016.

Violent protests against the rise in the cost of living erupted in Maputo and its largest suburb, Matola (de Brito et al. 2014), and it left six dead and hundreds injured in early 2008, after government announcement of substantial increases in the prices of gasoline and diesel due to imports prices increases (de Brito et al. 2014). Almost immediately after that, similar protests occurred in other parts of the country, but were quickly repressed by the police (de Brito et al. 2014).

Food price increases were contrasted by minimal raises in wages in most sectors (except for the financial services) while unemployment and underemployment were widespread (Figure 5.4 shows the different growth rates of real minimum wages by sector)[6]. A common trait within the popular discourses reported in de Brito et al. (2014)[7] on the cost of living and difficulties faced by vulnerable population, delineates a picture of widespread discontent with wages that were perceived far below subsistence level and declining year after year. With prices of basic goods increasing, the popular perception reflected fears over declining and unstable real wages. Large number of families reported that they pursued more than one source of employment (often informal) to deal with their monthly expenses (de Brito et al. 2014).

Staple foods represent an important source of calories especially for poor Mozambicans, and their prices experienced sharp increases during the period in focus. Additionally, as food represents the largest share of household expenditure, in both urban (67.3%) and rural (49%) areas[8], food price inflation had greater adverse effects on poorer households.

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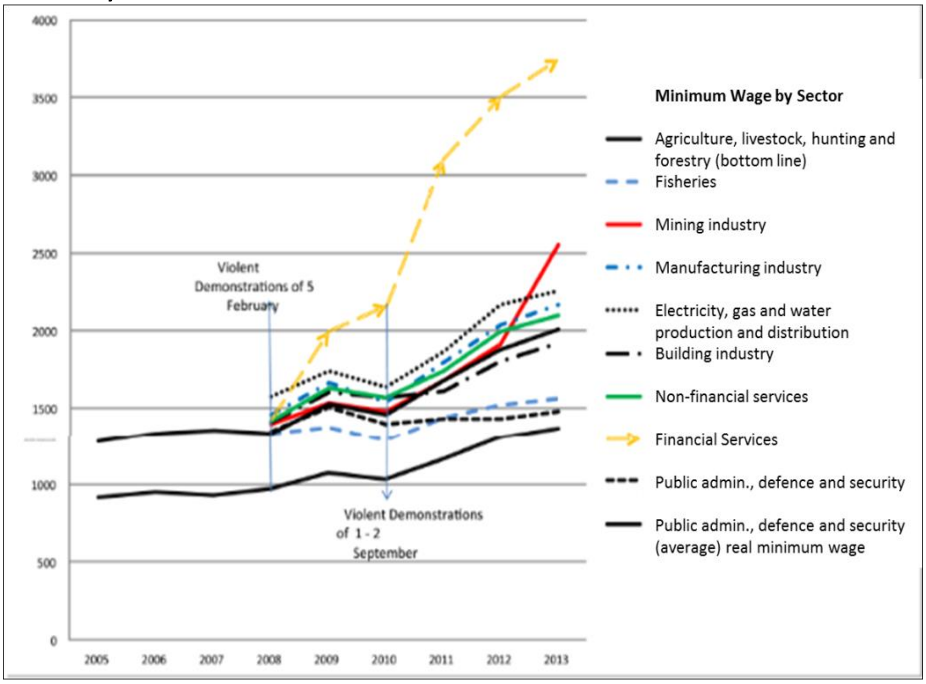
[6] The minimum wage is defined as the threshold below which no employer is legally allowed to pay its employees. Each year, the government, following consultations with the Consultative Labour Commission fixes 11 minimum wages, corresponding to 11 major employment sectors in Mozambique (Wage Indicator Foundation, 2011)

[7] This section owes much to the Institute of Development Studies (IDS) and the Institute of Social and Economic Studies (IESE) report on Food riots and popular protests in Mozambique. It has provided extensive qualitative information on popular discourse on issues relative to food access, security and nutrition. The stories that are reported in the following paragraphs were collected during interviews held in Maputo's neighbourhoods of Maxaquene, Chamankulo and Ferroviário.

[8] A detailed description of food expenditure and food staples is presented in Table 5.13 in the following section dedicated to staple food consumption patterns in Mozambique.

Figure5.4 Evolution of the Real Minimum Wage in Mozambique, by sectors of production (in Meticais) – 2005 to 2013



Source: de Brito et al. (2014)

Faced with the rises of food prices, interviewed households in de Brito et al. (2014) were forced to eliminate non-food goods, considered as less of a priority, while reducing the frequency and quantity of consumption of more nutritious foods (i.e. chicken, itself already a substitute to beef, eggs and others sources of proteins), due to lack of resources to purchase food. Only families that were relatively well-off and had some room for manoeuvre to adapt their diets, managed to replace expensive food item with cheaper alternatives. Section 5.3.3 looks in more detail at the composition of household consumption expenditure providing more evidence on the importance of food purchase on total expenditure in both urban and rural areas (despite having more access to land) and especially among the poor.

5.3 Data description

This section first describes the main features of the MCES calculated for Mozambican households (5.3.1) and subsequently provides an overview of the characteristics of the comparator measures of food and nutrition security [9] employed in the validation (5.3.2). This section serves to introduce the reader to characteristics and severity of malnutrition and food insecurity in the country. The section concludes by discussing staple food expenditure patterns in Mozambique, reinstating the importance of food and staple food purchase, as well as

[9]Namely, Household Dietary Diversity score, Self-Assessed Food Insufficiency information and child anthropometric measures.

emphasizing the differences in food purchase patterns between different income groups (5.3.3).

5.3.1 The MCES: calculation and main features

The MCES and the beta coefficient associated with it, is the variable of interest in the validation analysis. As described in Chapter 2, the index is expressed as a percentage and represents the share of expenditure required to purchase a minimum amount of energy deriving from staple foods. Equation 5.1 indicates the formal specification of the indicator that calculates household MCES at the monthly level:

Equation 5.1

$$MCES = \frac{\sum_{i=1}^{n}((P_x * w_x/K_x) * HHminKcal_i) * month}{HHmonthly\ consumption\_exp_i}$$

The MCES includes monthly village level prices for the main staples consumed by households in Mozambique. This category includes maize and cassava flour, rice, sorghum sweet potato, fresh and dried cassava. They represent a significant share of staple foods purchased by households in Mozambique and a more detailed discussion of purchasing pattern in Mozambique is provided in Section 5.3.3.

The weighting system (w) assigned to each price correspond to the household specific share of calories purchase (for each staple food item) on the total staple food basket purchase. After calculating the total calories (from staples only) purchased by each household, it was possible to derive the individual purchase share of each item over the total staple food basket purchase[10].

Weighted prices are then divided by the calorie density of the product they refer to. This exercise allows to calculate an indexed price of one calorie unit. The National Food Composition Table for Mozambique produced by Korkalo and colleagues (2011) is used to complete this exercise.

The indexed price of one representative calorie (composed by the main staple foods purchased by the household) is multiplied by the minimum household (adult equivalent) calorie requirement. This operation calculates the cost for purchasing staple foods to cover a household's minimum calorie requirement for one day. The numerator's calculation ends by multiplying the latter by the periodicity of interest, in this case, a monthly frequency. After completing the calculation of the numerator, the computation of the MCES finishes by dividing

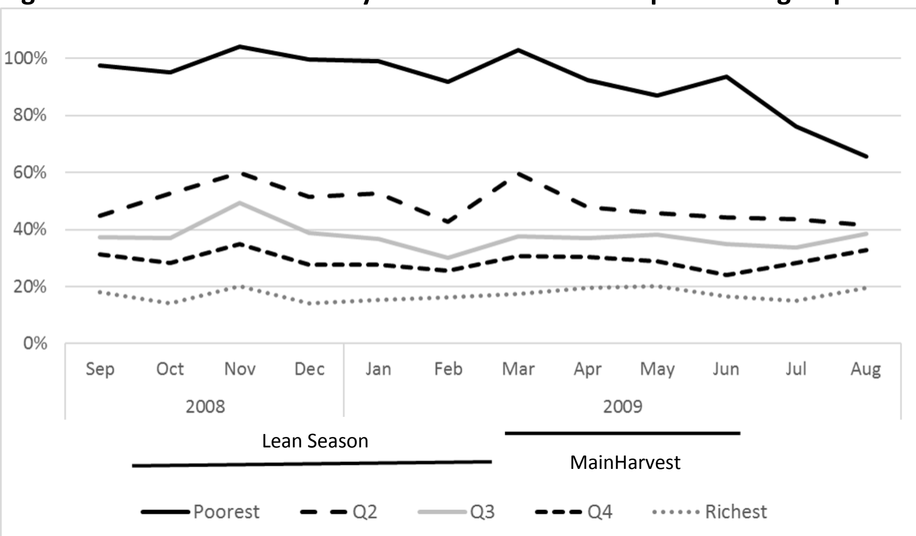
[10] More details on the weighting system can be found in Chapter 3.

the latter by the household monthly consumption expenditure. Due to inconsistencies in the terms of prices and household expenditure data or due to missing values, about 200 observation were deleted, reducing the sample by approximately 1.8%.

Figure 5.5 reports the results for the MCES calculated with IOF 200-2009 data for the Mozambican households, illustrating the expenditure group breakdown (in quintiles) between September 2008 and August 2009. The figure offers an informative picture in terms of the experience of food price fluctuation faced by different income groups and how this varies over time. For example, the MCES relative to the poorest households indicates that their purchase of calories will require 66% to 104% of their income. It is interesting to note that the highest values are recorded during the lean season (that takes place between October and early March in a typical year[11]). While appreciating the substantial distance between the MCES of the poorest households and the other expenditure groups, the relatively high values for the second and third income quintile are notable. Households in the second and third expenditure quintile need on average 42% to 60% and 30% and 49% (respectively) of their incomes to purchase their minimum energy requirement from staple foods.

The availability of monthly data allows to observe the MCES variations over time and showing how monthly fluctuations it differs between expenditure groups. While the MCES for poorer income groups exhibits substantial monthly fluctuations, the extent by which the MCES varies over time decreases for more affluent groups.

Figure5.5 The MCES – Monthly trends for different expenditure groups



Source: Author, using IOF2008-2009 data

[11]Appendix E illustrates a crop calendar for a typical year in Mozambique.

5.3.2 Overview of the comparator measure on food and nutrition security

This sub-section presents the characteristics and trends of the three main comparator measures of food and nutrition security used to analyse the validity of the MCES at the household level using the Mozambican data. The description starts with the outline of the Household Dietary Diversity Score (HDDS), it continues with estimates for child anthropometrics measures and concludes with information on Self-Assessed Food Insecurity (SAFI)[12]. The discussion covers general features of the indicators (that include rural-urban and provincial differences) before focusing on patterns and trends based on households' expenditure distribution and seasonality. These are recurrent themes across the thesis and crucial features included in the computation of the MCES. An analysis that takes into account the interconnection between household expenditure and seasonality before presenting the results can familiarize the reader with some recurring patterns that will be disclosed from the findings of the validation assessment.

The information gathered in the daily expenses module of the family household allowed the calculation of the **Household Dietary Diversity Score** (HDDS). Following Swindale and Blinsky's (2006) guidelines on household dietary diversity measurement, a 12 food–group classification is used. Table 5.6 illustrates the national estimates of HDDS as well as a breakdown by expenditure quintile; the national average HDDS is 6, and figures illustrate that dietary diversity increases with expenditure. The mean HDDS for the lowest wealth quintile is 4.8, while the mean HDDS associated with the highest wealth quintile is 6.7. A similar pattern can be appreciated when looking at the distribution of HDDS between different expenditure groups in rural and urban areas, although scores in urban areas are always higher than those in rural areas.

[12] The reader may consult Chapter 3 for the characteristic and the selection criteria of these indicators

Table 5.6 Household Dietary Diversity Scores – expenditure group and location breakdown

	Mean	Std. Dev.	Min	Max
All	6.0	2.0	1	12

Expenditure group	All	Rural	Urban
Poorest	4.8	4.5	5.9
	(1.8)*	(1.7)	(1.6)
Q 2	5.9	5.6	6.9
	(1.8)	(1.6)	(1.6)
Q 3	6.3	6.1	7.2
	(1.7)	(1.6)	(1.6)
Q 4	6.4	6.2	7.3
	(1.7)	(1.6)	(1.7)
Richest	6.7	6.6	7.4
	(1.9)	(2.0)	(1.8)

Mean HDDS ANOVA: rural-urban differences and difference by expenditure groups statistically significant (Anova F p<0.01). Standard deviation in parenthesis. Source: Author, IOF 2008-09 data

Significant differences of dietary diversity are also noticeable over regional distribution (Table 5.7). The North manifests the highest HDDS while Southern and Central regions exhibit lower scores. The rural-urban distinction in the table reflects the general rural-urban pattern, with urban areas in the province of Nampula (in the north) showing the highest value (7.4) and rural areas in Gaza and Inhambane (in the south) reporting the lowest values (4.9).

Table 5.7 Household Dietary Diversity Score regional distribution

	Spatial Domain	HDDS	st. dev	max
North	Niassa & Cabo Del Gado-rural	6.22	1.74	11
	Niassa & Cabo Del Gado-urban	6.85	1.95	12
	Nampula-rural	6.21	1.69	11
	Nampula-urban	7.13	1.86	11
Centre	Sofala & Zambezia-rural	5.35	1.72	10
	Sofala & Zambezia-urban	6.47	1.75	11
	Manica & Tete-rural	5.01	1.90	10
	Manica & Tete-urban	6.66	1.88	11
South	Gaza & Inhambane-rural	4.77	1.78	10
	Gaza & Inhambane-urban	5.79	2.06	11
	Maputo Province-rural	4.67	2.05	9
	Maputo Province-urban	6.44	1.90	12
	Maputo City	6.97	2.04	12

Mean differences between spatial domains are statistically significant (Anova F p<0.01)
Source: Author, IOF 2008-09 data

Table 5.8 presents the seasonal variation (based on quarterly measurements) of HDDS by geographical zones of Mozambique, namely North, Centre and South. There is notable variation in terms of dietary diversity for Mozambican households over the survey year. In all the three parts of the country, HDDSs reach their lowest levels in the second and the third quarter of the year, before recovering in the forth. This trend tends to follows the crop calendar and all low values correspond to regional lean seasons, taking place between December to mid-March in Northern regions and between October and February in South and Central regions (crop calendar presented in Appendix E).

Table 5.8 Household dietary diversity score distribution by survey quarter and geographic zone

	North		Centre		South	
Survey quarter	HDDS	st. dev	HDDS	st. dev	HDDS	st. dev
Sept-Nov 2008	6.79	1.78	5.82	1.88	6.07	2.24
Dec08-Feb09	6.06	1.98	5.66	2.08	5.85	2.22
Mar-May 2009	6.40	1.76	5.33	1.86	6.00	2.11
June-Aug 2009	6.79	1.72	6.06	1.70	6.10	2.03

Mean differences between survey quarter by geographical zones are highly significant for Northern and Central region (Anova F $p<0.01$) while the mean difference for the Southern regions is significant at less than 10% level (Anova F $p<0.1$).
Source: Author, IOF 2008-09 data

Anthropometrics measurements (weight and height) together with age and sex were collected for all sampled children below 5 years of age. Z-scores have been computed based on the WHO (World Health Organization) Child Growth Standards (2006). Based on the guidelines (WHO 2006), this thesis considers z-scores up to -2 as normal, between -2 and -3 critical but moderate undernutrition levels and z-scores lower than -3 are considered indication of severe undernutrition.

With regards to all three indicators, the Northern and Central regions report the highest prevalence rates, with the south exhibiting the lowest percentages.

Table 5.9 shows that 43% of all children under five are stunted (of which 21% severely); 17% are underweight (of which 5% severely); and 7% are wasted (of which 2.5% severely). These figures raise serious concerns in terms of child undernutrition. Following the cut-off points suggested by WHO and illustrated in Table 5.10 the national prevalence of underweight and wasting rates can be considered medium. However, stunting presents very high prevalence within some parts of the countries with even more critical situations.

Irrespective of the indicator, all three undernutrition measures are consistently higher in rural areas. As noted by Ruel and colleagues (1998), in most developing countries it is common for urban children to have better health and nutritional status compared to children in rural areas. Urban children are generally taller, heavier, and are less likely to have suffered from diarrhoea, cough, or fever in the previous two weeks than children living in rural areas (*Ibid.*).

Table 5.9 Prevalence of child (0-59 months) undernutrition by location

		Underweight %		Stunting %		Wasting %	
		moderate[a]	severe[b]	moderate	severe	moderate	severe
North	rural	23.3	7.0	53.8	28.6	7.8	3.9
	urban	18.1	5.0	45.9	22.8	6.9	2.7
	Total North	21.3	6.2	50.9	26.4	7.5	3.4
Centre	rural	21.6	6.7	50.3	26.5	8.1	5.6
	urban	18.4	4.6	44.0	22.2	7.9	3.0
	Total Centre	20.6	6.0	48.3	25.1	8.0	2.6
South	rural	11.6	3.7	33.1	13.6	3.5	1.1
	urban	7.6	2.6	24.8	9.2	4.9	1.7
	Total South	8.9	3.0	27.6	10.7	4.4	1.5
Total		17.4	5.2	42.9	21.2	6.8	2.5

[a] moderate = Z-score between -2 and -3 Z-scores
[b] severe = Z-scores lower than -3 Z-scores
Percentage differences between rural-urban areas and geographic location (North, Centre, South) statistically significant (Anova F p<0.01)
Source: Author, IOF 2008-09 data

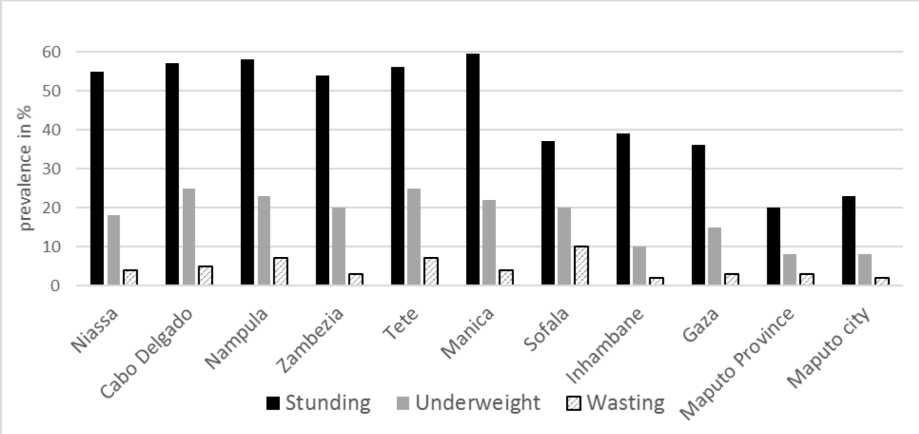
Table 5.10 WHO classification for assessing severity of undernutrition by prevalence ranges among children under 5 years of age

Indicator	**Severity of undernutrition by prevalence ranges (% of chindren below -2 Z-score)**			
	Low	Medium	High	Very high
Stunting	<20	20-29	30-39	>=40
Underweight	<10	10-19	20-29	>=30
Wasting	< 5	5-9	10-14	>=15

Source: WHO (1995b)

A closer look at the provincial trends of undernutrition indicators in Mozambique (Figure 5.6) confirms the trends appreciated in Table 5.9, with the North and Centre systematically underperforming compared to provinces in the South. While a look at all three indicators provides no single story about undernutrition across the regions, if single indicators are taken individually, Cabo Delgado and Tete (underweight), Manica (stunting) and Sofala (wasting) are among the provinces with the highest prevalence of undernourished children.

Figure 5.6 Child undernutrition indices by province



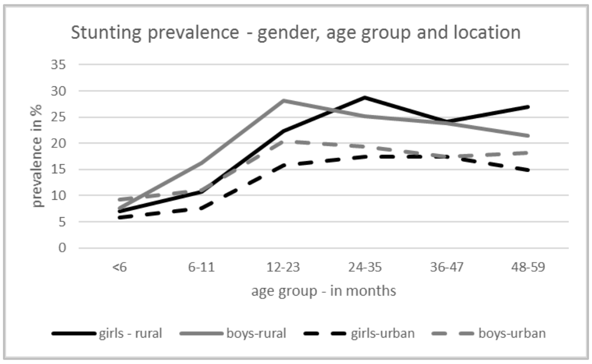
Percentage differences between provinces statistically significant (Anova F p<0.01)

Source: Author, IOF 2008-09 data

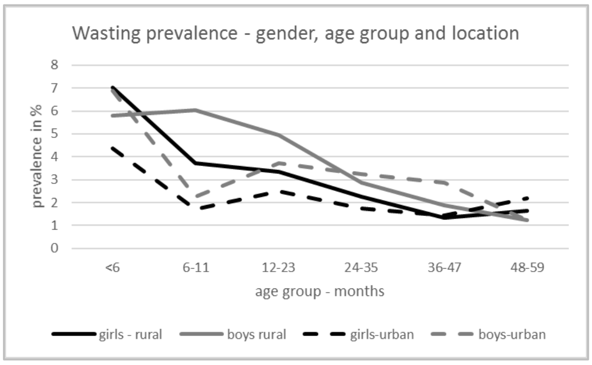
Gender disparities are evident when comparing undernutrition indicators among boys and girls. The distribution of stunting prevalence between boys and girls per age group and location (Figure 5.7– panel A), reveals that prevalence of stunting increases progressively with childrens' age-group and reaches a plateau around the 24th month.

Figure 5.7 Stunting and wasting prevalence per age group, gender and location

A



B

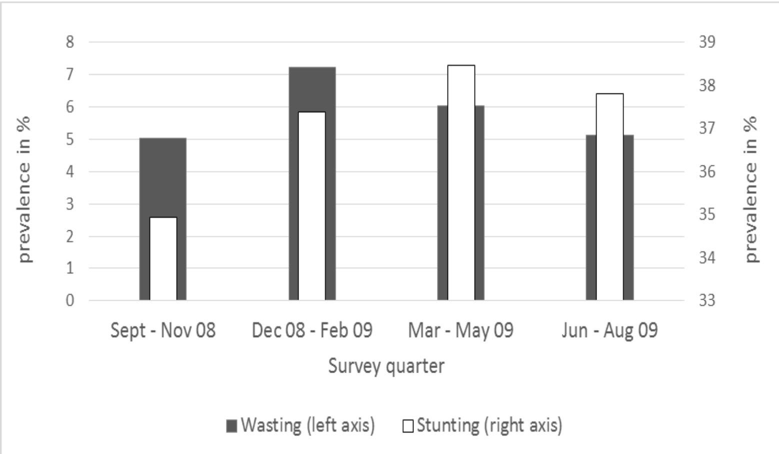


A different situation is appreciated in looking at the prevalence of wasting among girls and boys by different age groups and location (Figure 5.7–panel B). Wasting prevalence is higher at younger ages and gradually declines as children grow older. Except for very young baby-girls in rural areas, boys tend to report higher levels of wasting than girls across age groups in both urban and rural areas.

Percentage differences between age group and gender statistically significant (Anova F p<0.01) for stunting prevalence only.
Source: Author, IOF 2008-09 data

Similarly to the HDDS, there are marked seasonal variation of child undernutrition in Mozambique. Figure 5.8 shows the monthly trends of stunting and wasting prevalence from September 2008 to August 2009. Based on quarterly averages, both wasting and stunting show peaks in the second and third quarters of the year and fall in the fourth quarter of the year. The peak period corresponds to the *hunger season*, which normally runs between December through to February (Arndt et al. 2005). While stunting is related to multiple factors that impact children nutrition status, a general pattern that supports the hypothesis on the seasonal nature of stunting and wasting, and possibly links with seasonal food prices fluctuations, can be appreciated. It is not unusual to encounter seasonal patterns in the fluctuation of undernutrition levels, food consumption and seasonal price variations (Devereux 2002). For example, Arndt et al. (2005) observe seasonal association between price variations and calorie consumption among households residing in rural ares in the north and the centre of Mozambique, with calorie consumption lowering during food price increases.

Figure 5.8 Prevalence of stunting and wasting by survey quarter – Sept 2008 to August 2009



Percentage differences between survey quarters are statistically significant (Anova F $p<0.01$)

Source: Author, IOF 2008-09 data

The description of the three measures on **Household Self-assessed Food Insufficiency** (SAFI) conclude this section. The IOF 2008-2009 module dedicated to poverty indicators asks three questions that capture food insufficiency:

1) Meals number: How many meals did this household have yesterday (none to three)?
2) Monthly food shortage: In which months did this household have problems with food?
3) Food sufficiency: During the past month the food in the household was: insufficient, sufficient, more than sufficient?

On average households were able to eat at least two meals the day preceding the survey (2.27 meals). While the percentage of households having completely skipped meals the day prior the interview is very low (about 1%), almost 10% of the households had eaten only one meal and more than 50% of the households reported the consumption of only two meals in the day prior to the interview (Table 5.11). This information provides only a crude picture of the frequency of food consumption, as it does not provide indications on what type of meals were consumed, their composition, and does not inform us on which member of the household has eaten the food. However, it can still be a useful indication on how meal frequency and other relevant variables (i.e. expenditure group) interact with each other and create patterns of food vulnerability. As illustrated in Table 5.11, households in the poorest income group consume the lowest number of meals, and only 20% of them consumed three meals on the day before the interview. However, families in the second and third income quintile report similar meal frequency patterns as well, with most them having consumed a sub-optimal amount of meals.

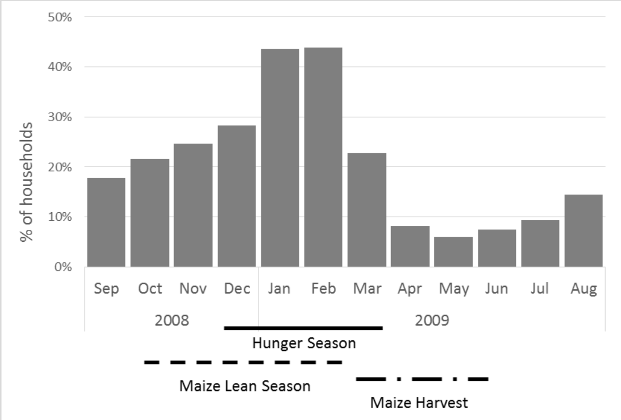
Table 5.11 Meals stability by expenditure quintile – number of households

		Expenditure quintile					Total by n. of meals	% of Total Sample
		Poorest	2	3	4	Richest		
# of meals eaten yesterday	0	42	11	15	13	32	113	1%
	1	312	168	152	154	132	918	8%
	2	1,372	1,297	1,211	1,070	815	5,765	53%
	3	441	690	788	928	1,187	4,034	37%

Mean differences between expenditure quintiles are statistically significant (Anova F $p<0.01$)
Note: Responses are to the question: How many meals did this household have yesterday?
Source: Author, IOF 2008-09 data

Moving on to the next SAFI indicator, Figure 5.9 illustrates the monthly breakdown of households' food shortage and exhibits stark seasonal patterns. The share of households experiencing food shortage gradually increases after the months in which maize harvest is completed, and reaches its highest figures at the peak of the lean season (December to February, corresponding to the *hunger season*). At its height, in these months, self-assessed food shortage affects over 40% of households in Mozambique.

Figure 5.9 Prevalence of household food insufficiency* by month - Sep 2008 to Aug 2009



Percentage differences between months are statistically significant (Anova F p<0.01)
* Responses are to the question: In which months did this household have problems with having sufficient food?
Source: Author, IOF 2008-09 data

This section concludes with looking at the final SAFI indicator, looking at levels of food sufficiency/insufficiency of the household in the month prior to the survey. Table 5.12 includes the average percentage of household responses to this question by survey quarter. While more than half of the households report sufficient food between August 2008 and July 2009 (58%), over 40% of the households experienced some form of food insufficiency in the same period and only 1.3% of the households reports that food was more than sufficient during the year. Similar seasonal patterns to the previous question are observed here. Household food insufficiency remains high during maize lean season (October to December -when land preparation and maize planting period takes place) and it begins to decrease prior the harvest and during the months when maize enters strongly public markets (March to June).

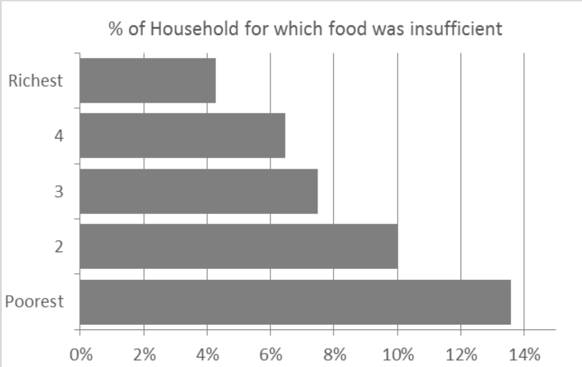
Table 5.12 Food sufficiency by survey quarter

Household food adequacy (%)	Aug-Oct 2008	Nov2008-Jan2009	Feb-Apr2009	May-Jul2009	Total
Insufficient	27.2	27.5	26.5	18.8	40.7
Sufficient	22.6	22.8	27.1	27.6	58.0
More than sufficient	27.4	19.3	30.4	23.0	1.3

Percentage differences between different groups by survey quarters are statistically significant (Anova F p<0.01). Note: Responses are to the question: During the past month the food in the household was: insufficient, sufficient, more than sufficient?
Source: Author, IOF 2008-09 data

To conclude and provide an additional dimension to the discussion about SAFI indicators,Figure 5.10 illustrates the trend of food insufficiency by expenditure quintile. Foreseeably, the relationship between food insufficiency percentage and expenditure quintile is negative confirming the trends illustrated in in Table 5.12. With almost 15% of the poorest households (first quintile of the household expenditure distribution) reporting food insufficiency in the month before the interview, these figures raise major concerns for food vulnerability production, a process that dynamically combines income generation and agricultural seasonality.

Figure 5.10 Household food insufficiency by expenditure quintile



Percentage differences between different groups by expenditure quintiles are statistically significant (Anova F p<0.01).
Note: Responses are to the question: During the past month the food in the household was: insufficient, sufficient, more than sufficient?
Source: Author, IOF 2008-09 data

This discussion introduces initial elements regarding manifestations of food insecurity in Mozambique which present repercussions in terms of HDDS, child anthropometrics and SAFI indicators. Furthermore, it also discusses a number of diverging signals between these indicators. For example, while dietary diversity scores are higher in the Northern regions than in South Mozambique (indicating that households in the north had better access to food variety), child undernutrition measures instead show a mirror picture. The prevalence of child undernutrition is higher in Northern and Central Mozambique and significantly lower in the South.

The seasonal nature of food insecurity is not surprising given the dependence of most rural households on subsistence farm production for income generation and food provision. Poor urban population heavily rely on markets to purchase their food and their thin purchasing power experiences significant pressures during periods of high food prices. Both rural and urban poor households rely strongly on food purchases and seasonal price fluctuations as well as global food price crises can significantly hamper their food and nutrition security. Seasonality, on one hand, is coupled with wealth and the ability of households to buffer food shortages (especially in rural areas), and on the other can deteriorate income generation prospects. This can be particularly dramatic for landless households that mainly rely on waged labour for their subsistence.

In addition, the focus on expenditure and seasonality is illustrative to the elements that shape the MCES. On one hand, the numerator of the indicator reflects price fluctuations generated by both seasonal (more expected but yet with damaging effects) price movements as well as global price shocks; on the other hand, the component of food insecurity associated with purchasing power and incomeis incorporated in the denominator of the MCES and reflects the ability of the household to maintain quantity, quality and stability of its food consumption. These themes will be examined further during the discussion of the main thematic issues, after presenting the findings of the validation assessment. The next section provides insights on the importance of food purchase, and in particular staple foods purchase of Mozambican households.

5.3.3 Staple food expenditure patterns in Mozambique

Food accounts for an important share of household total expenditure in Mozambique. Data on the average value of food to total value of household consumption expenditure ratio shows that over 58% of household consumption expenditure goes to food purchases, with the poorest households allocating on average 63% of their consumption expenditure on food (Table 5.13)[13]. Compared to urban households, rural dwellers spend a relatively larger percentage of their total expenditure on food (67.8%)[14], confirming the importance of food purchased from the market for rural households as well as for urban households. It is important to note that such percentage is particularly high relative to the average monthly expenditure of rural households (estimated at 2,466 MT in 2008/2009) representing only 50% of the average monthly expenditure of their urban counterparts (de Brito et al. 2014). This means that, even though rural households normally have greater access to land and are able to produce food to meet part of their consumption, they also devote a large share of their income to food acquisition, which makes them vulnerable to food price instability (since they are poorer that urban households and dependent on markets for food acquisition).

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[13]Average share of food on total expenditure remains high also for the 2nd and 3rd income quintile, 66.2% and 66.8% respectively.

[14]A closer look at the composition of household food expenditure by food groups reveals that the food items that absorb most of rural households' income are fish and sea food (almost 30% of total budget and 10% more than urban households). For detailed household food purchase breakdown, see Appendix F.

Table 5.13 Staple carbohydrate budget shares in Mozambique [a] – all households, rural-urban and expenditure quintile breakdown

	% Share of food in total value of food and non-food consumption				% Share of main staple foods in total value of food consumption[a]			
Households	All	Poorest	Rural	Urban	All	Poorest	Rural	Urban
Average Values	58.9	60.6	67.8	49.3	15.3	18.6	14.5	16.2

% Share of individual main staple foods in total value of staples purchase

	Rice	Maize Flour	Mandioca (fresh and dry)	Sweet potato	Mandioca Flour	Other Flours
All	47.1	28.7	6.9	6.6	4.8	1.6
urban	49.5	27.9	7.3	6.7	3.0	2.0
rural	43.0	30.1	6.3	6.4	8.1	0.9
Expenditure Quintile						
Poorest	25.6	40.8	8.7	3.5	15.2	0.5
Q 2	38.7	35.0	7.6	5.8	7.4	0.8
Q 3	49.6	28.6	5.7	5.8	3.6	1.2
Q 4	53.4	24.6	6.0	8.4	2.6	1.4
Richest	54.0	23.8	7.2	7.3	1.8	2.6

Note: It includes only purchased products. It excludes food that is produced, received in kind and received for work remuneration. [a] Main staple foods refer to cereals and tuber flours (maize, wheat, sorghum, millet, mandioca and others), tubers (sweet potato, fresh and dry mandioca), cereals -in grains- (rice, maize, wheat, oat, sorghum, millet, rye and barley). Source: Author, IOF 2008-09 data

On average, the value of main staple carbohydrates (cereals and tubers – flour and in grain) accounts for 15.3% of total food expenditures among all households and about 18.6% among the poorest households[15].

The main staple consumed by most Mozambican households (listed in the lower panel of Table 5.13), range between 47% (rice) and 2% ("other" flours) on households' expenditure on main staple

Box 5.1 Food purchase patterns in Mozambique.

Food absorbs a large portion of total consumption expenditure of households in

[15] In their study on staple food price affordability in urban Zambia and Kenya between 1991 and 2008, Manson and Donovan (2011) calculate that the main staple carbohydrates (maize, wheat, and rice in Nairobi; maize, wheat, rice, and cassava in urban Zambia) account for 27.5–30.9% among the poorest quintile of households. Compared to these results, the share of main staples on total food expenditure in Mozambique appears relatively low.

foods. While data show a relative homogeneity in staple food purchase between rural and urban households (with the exception of mandioca flour many consumed in rural areas), figures differ significantly across expenditure groups. For example, while globally rice appears to be the main staple consumed, the breakdown by expenditure groups reveals that rice is mainly bought by better-off households (mainly in urban areas), representing more than 50% of their staple food expenditure. On the other hand, maize and mandioca flour are the dominant staples in expenditure terms for poorer families. While mandioca (fresh and dry) seems to be purchased homogeneously across all income groups (between 6-9%), other staples follow a pattern traceable to expenditure quintiles. Purchase of rice and sweet potatoes increase as income increases, while maize and mandioca flour expenditure are higher for poorer households and gradually decline as income improves[16].

Mozambique and the poorest ones devote more than 60% of their income to acquire food. This percentage remains high also for higher expenditure groups with the 2nd and 3rd expenditure quintile spending 66.2% and 66.8% of their budget on food (respectively).

As shown inFig. 1 (in Appendix F) fish and seafood absorb most of Mozambican food budget, especially among households at the centre of the expenditure distribution (2nd, 3rd and 4th quintile). Staple foods account for *circa* 15% of total food budget with this share decreasing as income increases. This is followed by vegetables, oils and fats, fruit, meat, nuts, sweets, legumes and seeds, spices and beverages. Poultry product, eggs and milk and dairy represent less than 1% of household's food budget. The distribution of the food purchase varies significantly across expenditure quintiles. Meat for example represents 8% of richer households food budget, only 1.5% of poorer household food budget is directed to this item.

5.4 Approaches and results of the MCES validation

This section is dedicated to the exposition of the approach, summary of the results and interpretation and discussion of the MCES validation assessment for the Mozambican case study. As the methodological approach is common for the two case studies, it is introduced and described in Chapter 3 (Section 3.3). The validation evaluates the association between the MCES and the comparator measures of food and nutrition security in three steps: (i) analysis of

[16] It should be stressed, that these percentages vary further by province. The Third National Poverty Assessment identifies 13 spatial domains with similar consumption patterns and uses the consumption bundles for the computation of the 13 regional poverty lines (MPD/DNEAP, 2010, pp.119–132)

the Pearson and Spearman correlation coefficients; (ii) econometric assessment; and (iii) robustness check.

The following section firstly summarizes the control variables used in the econometric analysis of the Mozambican case and then moves on in reporting the results. It finally engages in the discussion of the findings.

5.4.1 Control variables

As noted in Section 3.3 of Chapter 3, the final stage of the validation assessment uses several econometric estimation techniques to evaluate the association between the MCES and the selected food and nutrition security comparator measures: in total five models are estimated. The choice of the control variables included in the models is principally driven by considerations on the nature of food and nutrition security indicator that is used as a dependent variable in each estimation round. While some confounding factors are common across comparator measures, others are specific to the characteristics of the specific to each of them individually and vary from equation to equation. This section begins with describing the confounding factors selected in the models that analyse the association between the MCES, HDDS and SAFI indicators and concludes with those used in the association analysis with between the MCES and child anthropometric measures. The equations described in Chapter 3 and used in the MCES validation, are listed below (with the original equation numbering) for the reader's convenience.

Equation 4.5

$$\mathrm{Log}(E[HDDS_i|\mathrm{x_i}]) = \alpha + \beta_1 MCES_i + \beta_2 \boldsymbol{P} + \beta_3 \boldsymbol{HH} + \beta_4 \boldsymbol{PA} + \beta_5 \boldsymbol{s} + \beta_6 \boldsymbol{L} + \boldsymbol{\varepsilon}$$

Equation 4.10

$$Ln\, Pr(SAFI_j = i) = ln\, \alpha + \beta_1 MCES_h + \beta_2 \boldsymbol{P} + \beta_3 \boldsymbol{HH} + \beta_4 \boldsymbol{PA} + \beta_5 \boldsymbol{s} + \beta_6 \boldsymbol{L} + \boldsymbol{\varepsilon}$$

Equation 4.11

$$WHZ_{ih} = \alpha + \beta_1 MCES_h + \beta_2 \boldsymbol{P} + \beta_3 \boldsymbol{M} + \beta_4 \boldsymbol{C} + \beta_5 \boldsymbol{HH} + \beta_6 \boldsymbol{WS} + \beta_7 \boldsymbol{s} + \beta_8 \boldsymbol{L} + \boldsymbol{\varepsilon}$$

Equation 4.12

$$HAZ_{ih} = \alpha + \beta_1 MCES_h + \beta_2 \boldsymbol{P} + \beta_3 \boldsymbol{M} + \beta_4 \boldsymbol{C} + \beta_5 \boldsymbol{HH} + \beta_6 \boldsymbol{WS} + \beta_7 \boldsymbol{s} + \beta_8 \boldsymbol{L} + \boldsymbol{\varepsilon}$$

Drawing from D'Souza and Joliffe (2013a, 2013b) analytical approach, the model attempts to isolate the effects of changes of the MCES on HDDS and SAFI indicators by controlling for simultaneous price fluctuations of other important non-staple foods. This directly follows consumer theory that indicates consumption decisions can be determined by the price of other complementary or substitute products. Since all the main food staples prices are already included in the MCES index, the model includes a vector $\boldsymbol{P}$ of prices for products including edible oils[17] and fish. These prices are collected at the village level and the MCES employs monthly averages[18]. Edible oils and fish plus the commodities included in the MCES (maize, sorghum, rice, cassava and sweet potato) on average make up almost fifty percent of the food expenditure of an average household.

Vector $\boldsymbol{HH}$ gathers information on the household structure, housing characteristics and productive assets. These controls include household size, household head age, sex, and education (in years), elderly dependency ratio (ratio of dependent household members over 64 to the total active population -15 to 64) and young dependency ratio (ratio of dependent household members under 15 years old to the total active population -15 to 64), land, dwelling and livestock ownership, and sale of agricultural products. Land and livestock ownership are included to control for own-production and consumption of food as own food production can represent an important source of food intake, and buffer (at least in the short run) deterioration of dietary diversity and nutrition status during food price shocks. The dummy variable on the sale of agricultural products is included in the household characteristics vector to control for possible positive effects of food price increases for those households that market their produces.

Vector $\boldsymbol{PA}$ denotes variables that represent the physical accessibility to dietary variety, including distance to the closest major road (km) and presence of a daily market in the community (Snapp and Fisher, 2014).[19] The models includes a vector ($\boldsymbol{L}$) of variable that account for rural or urban location as well as categorical variables on geographical location (Northern, Central and Southern regions).

Although households were interviewed only once, each quarter of the IOF survey was designed to be representative of the whole population. This indicates that households interviewed in

[17] Vegetable oil is an important component of Mozambican food preparation tradition. In the period between 2004 and 2010, the annual per capita edible oil supply (mainly sunflower, rapeseed, palm and soybeans oil) was on average 8.8 kg (FAO Food Balance Sheet, accessed 15 June 2017). Mozambique produces and refines 35% of edible oil present of the market. The remaining 65% is supplied by imports from South Africa and Portugal, where oils are processed refined and packages in their respective countries and imported to Mozambique for sale (USAID, 2014).

[18] When prices were missing, mean monthly averages at the district level were calculated.

[19] The variable relative to the distance to the major road is derived from the question on the presence of buses or jitneys in the community. If there such facility is not available, the following question asks how many km one need to walk to reach the nearest bus or jitney. If a bus/jitney reaches the community, it is assumed that the main road is close (and the distance in KM equals zero) and the distance from the community to the main bus/jitney is used as equal to the distance to the main road. Likewise, in the absence of a reliable variable on the ownership of a refrigerator, this is calculated as a proxy of household access to electricity.

the first quarter should have similar characteristics to households interviewed the following quarters. This feature of the survey design is used to control for seasonality in the validation assessment and variable $\boldsymbol{s}$ is the binary variable that controls for maize lean season. Seasonality plays an important role in determining recurring food security and health related crisis (Devereaux 2009). The repercussions of seasonal changes on food intake and food security can also spread to urban areas. This is the case for urban families whose income does not meet the minimum level of resources needed to buffer seasonal price fluctuations and creating the circumstances to suffer from seasonal hunger (Becquey et al 2010).

The assessment of the association between the MCES and child anthropometric indicators (weight-for-height z-scores and height-for-age z-score) includes an additional set of control variables that are more specific to the comparator measures in use. As noted previously, some control variables are common to the validation assessment between MCES and the three different categories of FNS indicators. Hence, the remainder of the section will only describe the variables that are different to the previous association assessment. These include $\boldsymbol{M}$, a vector of variables on maternal characteristics, such as age and education (in years). These characteristics are typically found to be strongly associated with child nutritional status and growth (Arimond and Ruel 2002, Ruel and Menon 2002). Vector $\boldsymbol{M}$ also incorporates information on child breastfeeding in terms of number of exclusive breastfeeding months, a well recognized factor that affects child nutrition status (WHO 1995, Brown 1998).

Vector $\boldsymbol{C}$groups a set of child-related characteristics, such as child age group (in months), child sex, and birth order[20] (Behrman 1988, Horton 1988). Drawing from Arimond and Ruel's (2002) analysis, together with household characteristics (as noted, gathered under vector $\boldsymbol{H}$) the model includes measure for access to safe water and improved sanitation conditions (vector $\boldsymbol{WS}$).

[20] This can affect the allocation of nutrients to children and therefore influence their nutritional outcomes

Table 5.14 summarizes the confounding factors for the two sets of FNS comparator measures as well as the dependant variables and the MCES.

Table 5.14 Elements of the MCES validation: dependant and control variables

Variable Name	Variable Description	Measurement
HDDS and SAFI		
MCES	*Minimum Calorie Expenditure Share*	*% of household consumption expenditure required to purchase minimum energy requirement from staple foods*
HDDS	Household Dietary Diversity Scores	Numbers of food groups consumed (0 to 12)
Meals_num	Number of meals eaten by adults the day prior to the interview	0 to 3 meals
Food_suff	Household food security over the past 12 months (self-assessment)	Insufficient:1 Sufficient:2 More than sufficient:3
Dried_fish_price	Dried fish prices	Average monthly price (Metical/Kg) by village.
Serra_fish_price	Serra fish (sawfish) prices	Average monthly price (Metical/Kg) by village.
Sunflower_oil_price	Sunflower oil prices	Average monthly price (Metical/Litre) by village.
hhsize	Household (HH) size	Number of members in the household
Hsex	Sex of the head of the HH	0: Female/1:Male
Hhage	Age of the head of the HH	In years
Hhedu	Education years of HH head	0 to 17[21]
Aged_DepRat	Elderly dependency ratio	Number of dependents over the age of 64 to the total population, aged 15 to 64
Young_DepRat	Young dependency ratio	Number of dependents, aged zero to 14, to the total population, aged 15 to 64
land_ownership	Land ownership	0:No/1:Yes
House_ownership	Home ownership	0:No/1:Yes
livestock_ownership	Ownership of livestock	0:No/1:Yes
Sale_agr	Sale of Agricultural products	0:No/1:Yes

[21] The educational system of Mozambique operates on a 5-4-3-5 system: Primary school (5 years), Junior secondary school (4 years), Senior secondary school (3 years), University Bachelor's degree (5 years). The first twelve years of government schooling are free but there is an alarming number of children that do not go that far. Recent studies show that half of children who start primary school do not complete it (Unicef 2014).

Dist_mainroad	Distance to main road	Km
News	HH location by region	1: North/2:Centre/3:South
Urban	HH urban rural differentiation	1:Urban/0:Rural
Maize_lean_season	Maize lean season in months	1: lean season months (Oct2008-Mar2009) 0: non-lean season (Sept2008/April-Aug2009)
Child Anthropometric Measures		
Acute undernutrition	Child (under 5Y) Weight-for-height Z-score	Values from -5 to 5
Chronic undernutrition	Child (under 5Y) Height-for-age Z-score	Values from -5 to 5
Mother age	Mother's age	In years
Mother Edu	Education years of mother	0-17
Child_sex	Sex of the child	0:Boy / 1: Girl
Child_age_group	Child age group	1: <6 /2: 7-11/ 3: 12-23/ 4: 24-35/ 5: 36-47/ 6: 48-59
BO	Birth Order	1 to 6
Child_ill	Whether the child has been ill in the past 2 weeks child was ill	1:Yes/2:No
Improved_sanitation	HH has improved sanitation facilities	0:No/1:Yes
Safe_water	Water safety indicator: HH drinks piped water or treats the water before drinking	0:No/1:Yes
Breastfeed_month	N. of months child was exclusively breastfed	0 (never) - 31

5.4.2 Setting the hypothesis, results and discussion

Before moving to the presentation and discussion of the results, it is worth reminding the objective of the MCES validation process and the hypothesis that aims at testing. The MCES calculates the minimum energy expenditure, defined as the cost of a minimal calorie requirement from staple foods (considered the cheapest and most effective calorie option), as a share of the household total consumption expenditure (comprised of food and non-food purchase). Values of the MCES tend to be higher for low-income households and lower for households with higher incomes. The hypothesis tested in the validation exercise (based on the theoretical framework described in Chapter 2) is that increases of the MCES have detrimental effects on food and nutrition security indicators. Therefore, it is expected that the correlation coefficients and the estimate coefficient β_1(in Equations 3.5, 3.10, 3.11, 3.12) will be negative.

The following section presents the results of the association between the MCES and HDDS, anthropometric indicators and SAFI indicators. The discussion will blend in the presentation of results. The methodological approaches are indicated below:

- Calculation of Pearson correlation coefficients (index numbers that show the extent to which two variables are linearly associated) between the MCES and comparator measures of food and nutrition security. It is expected that the MCES is negatively associated with all food and nutrition security measures, that is, increases in the MCES represent a decrease (deterioration) of households' food and nutrition security status.
- Estimation of a count data model (Poisson log-linear models for count data) between HDDS (treated as dependent variable) and the MCES, under the assumption of a Poisson error structure (Hirvonen, 2016; Sibhatu, 2015; Snapp 2014). HDDS is treated as a count variable (exhibiting 12 possible outcomes) and a negative association between the HDDS and the MCES is expected.
- Estimation of an ordered logistic model between SAFI measures (treated as dependent variables) and the MCES. Two models are run for each SAFI measures, one with the number of meals eaten in the day preceding the interview (from 0 to 3) and another one with the food sufficiency status in the previous month (1: insufficient, 2: sufficient and 3: more than sufficient) as dependent variables.
- Estimation of an OLS regression between the MCES and weight-for-height z-score and height-for-age z-score, controlling for household characteristics and other determinants of nutrition status. Anthropometric indices are treated as dependent variables and a negative relation between the nutritional outcome indicators and the MCES is expected.

- *Results of the Pearson Correlation Coefficients.*

Table5.15 illustrates the Pearson correlation coefficients between the MCES and HDDS, child acute and chronic undernutrition and SAFI indicators. The first column provides the correlation coefficient for the entire sample, while the following blocks look at the correlation between MCES and FNS indicators by survey quarter and expenditure groups. Because more than one hypothesis is tested each time, Bonferroni adjustment is used to control for the family-wise error rate (Shaffer 1995).

Table5.15 Pairwise correlation analysis between MCES and FNS indicators

	Aggregate	Survey Quarter			
Indicator		Sept-Nov8	Dec08-Feb09	Mar-May09	Jun-Aug09
Dietary Diversity Indicator					
HDDS	-0.2800 ***	-0.3533***	-0.3078***	-0.3490***	-0.1415***
Self-Assessed food Insecurity					
N of meals (adults)	-0.1547***	-0.1191*	-0.2214*	-0.2179*	-0.1464*
Food sufficiency	-0.1575***	-0.1233*	-0.1903*	-0.1633*	-0.0983*
Anthropometric indices					
Child Wasting (by WHZ)	-0.0364***	-0.0265	-0.0435**	-0.0598***	0.0102
Child Stunting (by HAZ)	-0.0523***	-0.1079***	-0.0409**	-0.0109	-0.0502**

	Expenditure group (in quintile)				
Indicator	Poorest	Q2	Q3	Q4	Richest
Dietary Diversity Indicator					
HDDS	-0.1701***	-0.0028	-0.1242***	-0.0675***	-0.0006
Self-Assessed food Insecurity					
N of meals (adults)	-0.1073***	-0.0432**	-0.0423*	-0.0143	-0.0172
Food sufficiency	-0.0631***	-0.0358	0.0129	0.0654***	-0.0273
Anthropometric indices					
Child Wasting (by WHZ)	-0.0536***	-0.0117	0.0015	-0.0316	-0.0771**
Child Stunting (by HAZ)	-0.0823***	-0.0272	-0.0202	-0.037	-0.0886***

Asterisks *, ** and *** denote significance at the 10%, 5% and 1% level, respectively

Source: Author, IOF 2008-09 data

The correlation coefficients are consistent with the initial expectation, suggesting that increases of the MCES are associated with worsening of the selected food and nutrition security indicators. This thesis acknowledges the limitations of correlation coefficients, limitations that are mainly driven by the observed correlation being representative of just a section of the distribution of the variables, issues related to problems of false correlation, and by no means correlation coefficients are used to investigate causal relationships. The reader should note that this technique is primarily used to draw some initial empirical evidences regarding the direction of the association between the MCES and food and nutrition security indicators and to prepare the ground for the next step of the analysis.

Regardless of such limitations, correlation coefficients between MCES and FNS indicators are negative and statistically significant (p-value<0.01), when looking at results relative to the whole sample. There is some variation in the magnitude of such negative correlation, which appearsstronger for the HDDS and SAFI, and weaker for child stunting and wasting. The main assumption here is that the magnitude of the coefficient reflects the strength of the association between the MCES and other food and nutrition security measures.

The breakdown of the correlation coefficients for survey quarter provides some indication of seasonal patterns between the MCES and HDDS. The correlation between the MCES and HDDS is negative and significant (p-value<0.01) through the survey quarters, reaching its strongest levels at the beginning of the lean season (Sept-Nov) until the period that precedes the harvest (March-May). With the start of the harvest season, coefficient magnitudes increase, reaching a second peak. These changes can indicate that there are seasonal variations in terms of staple food prices, household expenditure and household dietary diversity. This gives room to explore whether higher prices and scarcity of food are likely to exercise downward pressures on households' dietary diversity. The association between HDDS and MCES by expenditure group, despite the variability of the significance level of the correlation coefficients, exhibits a gradual tendency to decrease for higher income groups. This can mean that the MCES appears to be more sensitive to food security and nutritional consequences relative to food price fluctuations of poorer households. In fact, the correlation coefficient associated with the lowest income group appears to be the strongest in magnitude and it gradually decreases as household consumption expenditure improves.

With regards to the SAFI indicators, correlation coefficients for both number of meals consumed by adult members of the household and its food insecurity, are negative and statistically significant. Similarly to the HDDS, the association between these two variables and the MCES follows a pattern that reflects crop seasonality, with magnitude of the correlation coefficients varying from higher levels in the middle of the lean season to lower levels that coincide with the initial stages of the harvest. The association between the MCES and SAFI indicators appears to be stronger for poorer expenditure quintiles and gradually declines as households' expenditure increases.

The association between MCES and anthropometric measures appears noisier compared to previous indicators, especially when patterns by expenditure groups are observed. Both child wasting (by WHZ) and stunting (by HAZ) are negative and highly significant at the aggregate level. While the variation of the correlation coefficients associated with stunting does not provide a consistent seasonal pattern, correlation coefficients associated to child wasting reflect coherent trends in relation to the agricultural stages, with correlation strength increasing as the lean season advances. With the start of the harvest the sign of the correlation coefficient reverses. A previous study produced similar outcomes when looking at the seasonal variation of child wasting in Mozambique during the food price crisis (Arndt et al 2016). Seasonal patterns of child wasting reflect the importance of the relationship between prices, income and the *hunger season,* exacerbated by high inflation rates caused by the 2008-2009 international food and fuel price shocks.

The analysis of the correlation coefficients reveals that the association between the MCES and the comparator measures of food and nutrition security is generally negative. It also suggests that there are existing patterns over agricultural seasons and expenditure group. Indicators that capture short-term manifestations of food insecurity (acute undernutrition, deterioration of dietary diversity) or strategies to maintain energy intake in the short run (for example meal frequency and dietary diversity) appear to respond to a greater extent to variations of the MCES. Although only at the very initial stages of the analysis, these results indicate that the MCES can describe the short-term impacts of volatile food prices on different food and nutrition security outcomes. As noted, there are several limitations in using and interpreting correlation coefficients, and the use of this method represents an exploratory step of the MCES validation.

The following section looks at the relationship between these same indexes employing more complex ad hoc estimation approaches. General conclusions will be presented organically after overviewing the results of the models-based econometric analysis.

- *Estimates from the Econometric Analysis*

Three different sets of econometric estimations are used in this section. Following the order presented at the beginning of this section, the relationship between the MCES and HDDS is analysed by using a Poisson log-linear models for count data, Ordered Logistic models are used to look at the relationship between the MCES and SAFI indicators, and finally Ordinary Least Squares (OLS) for child anthropometric measures. After summarising and discussing the estimated results of these models, the analysis follows with taking a closer look at the seasonal and income distribution dimension of the study. Considerations on the limitations close the section.

Table 5.16 presents the regression outputs of the econometric analysis. The table reports only the estimated coefficients between the MCES and the comparator measures and full results are provided in Appendix G. Table 5.16 indicates the estimation technique employed for each round, the food and nutrition security comparator measure used as outcome indicator and the value of the estimated coefficients. Standard errors are reported in parenthesis and are based on heteroscedastic-robust standard errors (White 1980).

As noted, if the initial hypothesis – that food and nutrition security is negatively affected by fluctuations of the MCES (that captures the staple food price fluctuations and their consequent *income effect*)– is correct, it is expected that coefficients presented in Table 5.16 are negative.

Table 5.16MCES and the Food and Nutrition Security indicators - association at the household level[a]

Estimator	Outcome indicator	MCES coefficient
	Diet Diversity Indicator	
Poisson	HDDS	-0.257***
		(0.0087)
	SAFI	
Ordered Logistic	N. of meals - adults	-0.910***
		(0.0536)
	Food insufficiency	-0.830***
		(0.0582)
	Child Anthropometry	
OLS	Child Wasting (by WHZ)	-0.178**
		(0.0813)
	Child Stunting (by HAZ)	-0.204**
		(0.0924)

Robust standard errors in parentheses. Significance level: * p < 0.1. ** p < 0.05. *** p < 0.01.
[a] Full results provided in Appendix G
NB: The estimations use the confounding factors reported in Table 5.15 and discussed in Section 4.4.1 of this chapter.
Source: Author, IOF 2008-09 data

The Poisson count data model is used to examine the impact of MCES increases on the number of different food groups consumed by households in Mozambique[22]. The parameter estimates should be interpreted as the impact of the *i-th* independent variable (in this case the MCES) on the number of food groups consumed. The sign of the parameter estimates indicate the direction on the impact. Findings generally conformed to the hypothesis, with the MCES impact on HDDS being negative and significant (-0.257, p-value<0.01).

An ordered logistic regression model is used to assess the relationship between the MCES and SAFI indicators that are appropriately treated as ordinal dependent variables of an underlying continuous variable (Allendorf 2007). The odds ratios from the ordered logistic model can be interpreted as the factor by which a unit increase in the MCES variable will affect the odds of being in a higher or lower category of the two SAFI indicators[23]. The negative and highly significant association suggests that, when controlling for confounding factors, increases of the MCES are associated with reductions in the number of meals eaten by households and increases in reported household food insecurity (-0.910 and -0.830 respectively, both significant with p-values<0.01).

[22]For an overview of the Poisson justification as regards to the HDDS, see Appendix D.

[23]The responses are to the **Food insecurity question** are: *During the past month the food in the household was: insufficient, sufficient, more than sufficient (1-3)?* The responses are to the **Meals number question** are: *How many meals did this household have yesterday? (0-3)*

Finally OLS estimators are employed to assess the association between the MCES and child anthropometrics (measuring acute and chronic undernutrition). The estimated coefficients relative to the MCES are negative and significant suggesting that increases of the MCES are associated significantly with deterioration of wasting and stunting (-0.178, -0.204 respectively, and p-value<0.05) (see full result in Appendix G).

Overall, the MCES validation for the Mozambican case study indicates that increases in the food price indicator are closely associated with declines in household dietary diversity scores, reduced number of meals consumed by the household, deterioration of household food security assessment, and indicators of acute and chronic child undernutrition. These results allow to look into the initial hypothesis that the MCES can operate as an indicator of short-term impacts of food price fluctuations on food and nutrition security. Results illustrate that the MCES is more sensitive than indicators of household diet quality deterioration and acute child weight loss, closely associated with short-term variations of food availability. However, indicators of longer term manifestation of undernutrition (i.e. child stunting) appear to be also negatively associated with the MCES. Child chronic undernutrition is the outcome of various underlying elements, such as food intake, health and care, making interpretation of direct impacts cumbersome. However, the MCES methodology, that includes the expenditure element in its construct, could play a role in strengthening the link between food prices and child stunting via expenditure. Some of these implications are discussed in Section 5.5dedicated to the robustness checks.

The estimated association between the MCES and HDDS and SAFI (respectively) puts forward an indication on how Mozambican households made concessions in dietary quality because of the 2008/09 food price increases. Findings suggest that households have altered the composition of their diets and their meal quantities, likely to cutting back on more expensive nutrient-rich foods and moving toward cheaper foods. A shift towards a lower quality diet coupled with fewer meals can have serious implications, and in particular for groups that have high nutrient requirements (children, pregnant and lactating women, elderly and people with illness).

Especially when interpreting results on the association with anthropometric measures, several caveats should be taken in consideration. Because of the lack of data and the complexity of body adaptation in face of food price fluctuations (cyclical as well as exceptional) there is little clarity on the nutritional impacts of price shocks (Arndt et al. 2016, Torlesse et al. 2003). The estimated coefficients that reflect the association between the MCES and child wasting and stunting are negative and significant, hinting to the fact that, in Mozambique, increases in staple food prices were associated to deterioration of acute and chronic undernutrition of children under the age of five. This can present a potential methodological improvement that derives from employing the interaction between food prices and expenditure to proxy purchasing power. However, anthropometric indicators are susceptible to various factors, health being the most important, breastfeeding and care environment. Although the model controls for most of these factors, estimates should be interpreted with caution and previous studies have favoured other anthropometric measures deemed to better reflect the impact of food price changes on nutritional status (i.e. anemia, vitamin A deficiency) (Kiess et al 2000) that this study could not use due to lack of information.

Seasonality and Income Distribution

One of the analytical lenses used to look at the linkages between food price variations and food and nutrition security in this work is represented by the seasonal variation of households' food and nutrition security. Both seasonal contingencies and unexpected crises shape household's behaviours in terms of livelihood and food-specific strategies (Longhurst 1986). For poor families, food strategies are at the core of their survival and often damaging coping mechanisms are adopted to minimize food intake changes, leaving households more exposed to future crises – for example selling critical household assets ,withdraw of children from school- (Hauenstein Swan et al. 2010).

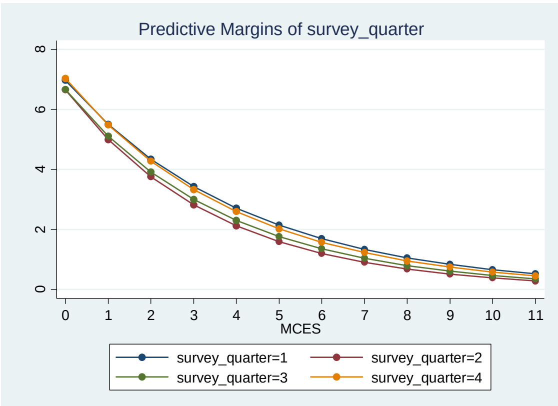
Income distribution is the other dimension through which the analysis is carried out. The consideration of the diversity through which food prices impact food and nutrition security of different income groups is incorporated in the construct of the MCES and is a recurrent theme in the description of the food and nutrition security indicators used in the validation. As poor and non-poor households are characterized by different food consumption patterns and expenditure priorities, food price increases will have a different impact on each of them (Dorward 2013).

Marginal effect graphs are therefore used to explore and visually represent the relationship between the MCES and comparator measures of food and nutrition security. Interaction terms disaggregate the association between different variables across the dimensions of income and agricultural season, providing further understanding on what lays behind the estimated coefficients. Margin refers to a statistic computed from the prediction of a model while manipulating the values of its covariates (Jann 2013). Marginal effects refer to differences in levels of margins if covariate values are changed (i.e. survey quarter and expenditure level) while all other variable are kept constant.

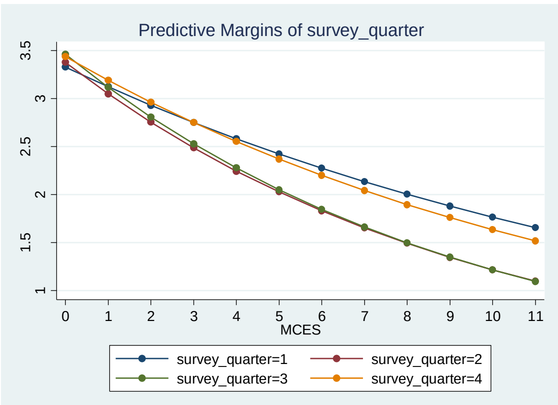
The full set of marginal effects plots can be found in Appendix H, including interaction effect plots for MCES and survey quarter time units and expenditure quintiles respectively, together with the associated diagnostics. The first plot shows the seasonal variation of the association between the MCES and different comparator measures and the second one depicts income distribution effect of the said association. This chapter reports the plots that depict the seasonal dimension of the association between the MCES and HDDS and SAFI indicators as they represent a more homogeneous pattern across indicators associated with short and medium-term impacts of food price increases on food security (Figure 5.11). The interaction with expenditure quintiles will be addressed at the end of this section and the graphs can be seen in Appendix H.

Figure 5.11 Interaction Effect between MCES and survey quarter for the models that analyse the association between MCES and food and nutrition security indicators

HDDS



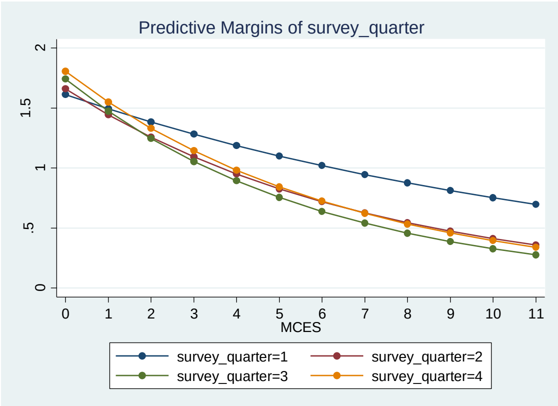
SAFI 1. Number of Meals



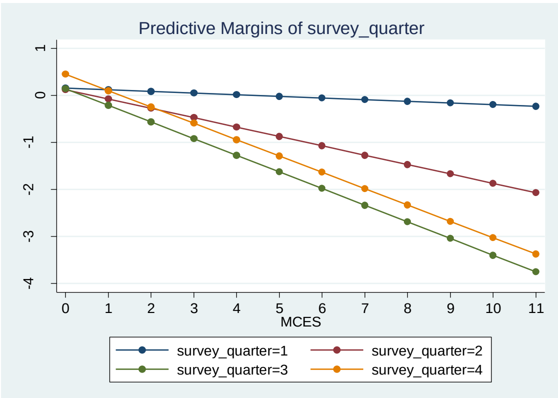
The graphs depicted in Figure 5.11 illustrate the predicted value of each dependent variable on the Y axis given the MCES value on the X axis, split up by the quarter in which the survey data was collected. The shape of the curves indicate in all three cases that the relationship between MCES and the other indexes is negative, as discussed with the results of the regression models.

The indicators reflecting dietary diversity, meals number consumed by adult members of the household and food sufficiency reported by the household, exhibit different patterns across the different quarters during which the survey was collected (especially in the case of the two SAFI indicators). As mentioned previously, the lean season occurred during the period between the third and fourth survey quarter (Oct-Apr, with the

SAFI 2.Food Sufficiency



Child Wasting (by WHZ)



Source: Author, IOF 2008-09 data

hunger season normally taking place during Dec-Mar), while harvest and immediate post-harvest period correspond the forth and first survey quarter respectively. The pattern of the association between the MCES and its comparator measures appears to be different over survey quarter, especially for the two SAFI indicators. In fact, the shape of the curve, and in particular the degree of its concavity, indicates the strength with which changes in MCES are reflected in changes in the indicator used as the dependent variable.

In the three examples, the curves corresponding to the lean season (green and red) exhibit higher degree of concavity and negative slope, suggesting that the (statistically significant) negative impact of the MCES on these indicators is greater during the lean season. In particular, it appears that indicators that capture household dietary diversity indicator exhibit a quadratic association with the MCES. This hints at non-linearity in the relationship between the MCES and this class of indicators and higher levels of MCES being associated to higher degrees of deterioration of dietary diversity, meals number consumed and food insufficiency.

Limitations

The relationship between prices, expenditure, food intake and nutrition can suffer of simultaneity as their correlation could seize the effect from prices and expenditure to food and nutrition security or the reverse. Correlation between the explanatory variables and the error term is a classic argument of simultaneity problem (Deaton 1997). Single period household surveys and regression models are often limiting and can produce biased estimates. On one hand regressions are the standard interface for the analysis of survey data (frequently providing useful summaries of the data), but encounter several limitations. This is particularly true when survey data are poor substitutes of unobtainable experimental data (Deaton 1997). Situations where endogeneity arises in econometric analysis of price-income-consumption are common. An additional layer is added when nutritional outcomes are taken onto account. In virtually all instances where econometrics attempts to replicate or empirically demonstrate the theory, analytical challenges are unavoidable. The first type of obstacle resides in the availability of datasets that allow to take the necessary precautions and adopt adequate techniques. In this case for example, Instrumental Variables (IV) technique is often used to estimate causal relationships. However, due to the nature of the survey design and to the absence of temporal dimension, this technique did not result in improving the endogeneity issues in the models.

A potential limitation of the estimates is also represented by Missing Not At Random (MNAR) patterns. For example, the investigation of missingness patters of the data revealed that price data were generally missing for rural areas and in particular in the northern parts of the country, suggesting that due to the difficulty to reach rural areas, data were not collected. Two steps have been taken to measure the problem. Once the models were ran with the existing data, and a second trial was done with imputing average prices of neighbouring towns to those that are missing. The results did not alter significantly.

This thesis attempts to evaluate the validity of the MCES methodology, by using standard tools of empirical economic analysis, employing available secondary data sources and opting for models that better capture the nature of the dependant variables. All models use a standard Huber-Whitecorrection to estimate the sampling variance, which allows for correlation of the residuals within districts and multicollinearity checks reveal that this is not a problem for most of the control variables as the calculated variance inflation factors (VIF) are below the threshold of ten.

Finally, given the nature of the data, the empirical analysis discussed in Section 5.4.2 reflects on the repercussions of food price fluctuation on food and nutrition level at the household level. Due to resource limitations and technical obstacles there is a scarcity of databases that include dietary and wellbeing information on each household member, making individual level and intra-household analysis not practicable. The construct of the MCES includes data collected and adapted from household budget surveys. The validation analysis assesses the association between the price indicator and a set of food and nutrition security comparator measures at the household and individual level. The analysis suggests that the MCES is negatively and overall significantly associated with all indicators considered. However, due to the reasons discussed in section 4.1 and reiterated during the discussion of the validation results, anthropometric indicators are determined by factors of different nature and periodicity and interpretation on causal relationships should be done with special care

5.5 Robustness Checks

Robustness checksforthe MCES validation estimates compare the use of the MCES to individual staple food prices, and assess whether equally good or better results, in statistical terms, are produced. Three approaches are selected (as described in Chapter 3): Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC),F-tests for nested models and sensitivity and specificity analysis. The section discusses the results of each robustness check approaches individually.

Akaike Information Criteria and the Bayesian Information Criteria

Using the same model specification employed in the validation section for each set of food and nutrition security comparator measure (Equation 4.55, Equation 4.10 to 3.12), AIC and BIC are computed for two sets of alternative indicators: (1) the MCES; (2) average level of all staple food prices used in the MCES computation (in Meticais/Kg). AIC-BIC calculation select the model that minimizes the negative likelihood penalized by the number of parameters as specified in the validation equations. Results are reported in Table 5.17 and compare AIC-BIC values for the two alternative model specifications.

Table 5.17 AIC-BIC: alternative regression coefficient estimates for robustness check (Mozambique)

	HDDS	# of meals	Food insecurity over the past month	Wasting	Stunting
	Poisson	Odered Logisitc		OLS	
MCES	-0.257***	-0.910***	-0.830***	-0.178**	-0.204**
AIC	38450.39	15213.9	12102.05	14374.17	15940.08
BIC	38621.68	15398.09	12279.1	14555.25	16115.39
Individual staple food prices[a]	-0.0034***	0.011***	0.005**	-0.001	-0.004
AIC	32800.95	12877.44	10243.26	12111.64	13380.46
BIC	32968.23	13057.15	10416	12287.75	13556.84

Asterisks *, ** and *** denote significance at the 10%, 5% and 1% level, respectively

[a]Individual staple foods prices includes: maize flour, fresh manioca, dried manioca, and rice prices (village level monthly average prices-Meticais/Kg)
Source: Author, IOF 2008-09 data

Food prices when individually introduced in the regression produce regression coefficients that are generally in line with the initial hypothesis. Staple food prices are negatively associated with most of the food and nutrition security indicators. Individual food prices are negatively and significantly associated to the HDDS (p-value<0.001). While the price coefficients relative to the SAFI indicators are positive (and significant), the association between staple prices and child anthropometric indices is again negative (but not statistically significant). On the other hand, the coefficients relative to the associations between the MCES and the comparator measures are consistently negative.

In terms of AIC-BIC evaluation, which has the aim to assess which of the candidate models is has the highest "fit" but also the most parsimonious, this selection criteria appears to be more favourable of the models that include individual prices, as the AIC and BIC values are consistently smaller for the equations that use single prices instead of the MCES.

F-test for nested models comparison

The F-test for nested models is used to test a reduced model (one with only individual food prices) against the full model (one reduced model plus the MCES). The F-test shows whether the additional term (MCES) is significantly improving the overall explanatory power of the model or just adding unnecessary complexity to it.

Table 5.18 and Table.19 show the F-test results for the five food and nutrition security comparator measures that are used to assess the MCES validity. The first table illustrates the results for the HDDS and SAFI indicators, and the second table illustrates the F-test for the selected child anthropometric measures. The F-tests results for the first set of food and nutrition security indicators (namely HDDS, meals number and food sufficiency) are statistically significant (p-value<0.01), indicating that the introduction of the MCES in the model contributes to an improved prediction of the dependent variable, a contribution that is greater than its single elements (prices and household consumption expenditure) considered individually. In addition, regardless of the comparator measure, the coefficients associated to the MCES carry the expected sign and are statistically significant (p-value<0.01).

The same analysis for the anthropometric indicators, shows significant F-test results (p-value<0.1 for WHZ, p-value<0.01 for HAZ) and again confirms the contribution of the MCES to the simpler price model, improving its predictive power through its interaction between prices and household consumption expenditure.

Table 5.18 F-test for nested models comparison, 1 (Mozambique)

	(1)	(2)	(1)	(2)	(1)	(2)
	RestrictedModel	FullModel	RestrictedModel	FullModel	RestrictedModel	FullModel
VARIABLES	HDDS	HDDS	meals_number	meals_number	food_suff	food_suff
MCES		-0.815***		-0.0983***		-0.103***
		(0.0445)		(0.0122)		(0.00977)
Maize Flour price	-0.00965***	-0.00446**	0.00399***	0.00457***	0.000569	0.00118*
	(0.00229)	(0.00225)	(0.000768)	(0.000767)	(0.000618)	(0.000615)
Dried Mandioca price	-0.0172**	-0.00794	0.00864***	0.00978***	-0.00400*	-0.00280
	(0.00791)	(0.00772)	(0.00264)	(0.00263)	(0.00213)	(0.00211)
Fresh Mandioca price	-0.000558	0.0307***	-7.80e-05	0.00406**	-0.000216	0.00412***
	(0.00501)	(0.00517)	(0.00167)	(0.00174)	(0.00135)	(0.00140)
Rice price	-0.0284***	-0.0245***	-0.00593***	-0.00535***	-0.000214	0.000403
	(0.00365)	(0.00356)	(0.00122)	(0.00121)	(0.000981)	(0.000974)
HHExpenditure	0.000122***	9.40e-05***	3.35e-05***	2.98e-05***	1.71e-05***	1.32e-05***
	(5.34e-06)	(5.41e-06)	(1.78e-06)	(1.83e-06)	(1.44e-06)	(1.47e-06)
Constant	6.856***	6.890***	3.221***	3.223***	1.638***	1.641***
	(0.113)	(0.110)	(0.0376)	(0.0374)	(0.0303)	(0.0300)
Observations	6,162	6,162	6,207	6,207	6,188	6,188
R-squared	0.096	0.143	0.066	0.075	0.026	0.044
df_m	5	6	5	6	5	6
F	109.3	146.7	72.73	72.28	27.87	40.17
rss	21513	20401	2434	2409	1570	1542
F-test		335.5		65.07		111
Prob > F		0.0000		0.0000		0.0000
Standard errors in parentheses						
*** p<0.01, ** p<0.05, * p<0.1						

Table 5.5.19 F-test for nested models comparison, 2 (Mozambique)

	(1)	(2)	(1)	(2)
	RestrictedModel	FullModel	RestrictedModel	FullModel
VARIABLES	whz06	whz06	haz06	haz06
MCES		-0.0904*		-0.151***
		(0.0463)		(0.0545)
Maize Flour price	-0.00150	-0.000961	-0.000464	0.000408
	(0.00212)	(0.00214)	(0.00254)	(0.00256)
Dried Mandioca price	-0.0110	-0.0102	0.0444***	0.0457***
	(0.00753)	(0.00753)	(0.00892)	(0.00892)
Fresh Mandioca price	-0.0153***	-0.0112**	0.00652	0.0132**
	(0.00488)	(0.00530)	(0.00576)	(0.00624)
Rice price	-0.00863**	-0.00825**	-0.0236***	-0.0229***
	(0.00336)	(0.00337)	(0.00398)	(0.00398)
HHExpenditure	2.94e-06	-5.75e-07	2.91e-05***	2.32e-05***
	(5.25e-06)	(5.55e-06)	(6.19e-06)	(6.54e-06)
Constant	0.713***	0.724***	-1.678***	-1.659***
	(0.106)	(0.106)	(0.126)	(0.126)
Observations	4,321	4,321	4,334	4,334
R-squared	0.009	0.009	0.027	0.029
df_m	5	6	5	6
F	6.218	5.879	20.17	18.40
rss	10038	10029	14144	14120
F-test		3.822		7.614
Prob > F		0.0507		0.00582
Standard errors in parentheses				
*** p<0.01, ** p<0.05, * p<0.1				

Source: Author, IOF 2008-09 data

Sensitivity and Specificity analysis

An additional robustness check of the MCES against the comparator measures of food and nutrition security is performed via sensitivity and specificity analysis after performing a logistic regression. This is an intuitively appealing way to assess the “fit” of a logistic regression model. Logistic models seek to predict an event, which either takes place (positive outcome) or does not take place (negative outcome). The model can then predict a positive or negative outcome, which can be “verified” by looking at the actual observed outcome, determining four possible scenarios: a true positive outcome is predicted, a false positive outcome is predicted (the outcome did not realise, but the model predicts it did, a false positive), a true negative outcome is predicted, or a false negative outcome is predicted (the outcome did realise, but the model predicts it did not). The sum of true positive (sensitivity of the model) and true negatives (specificity of the model) is defined as the quantity of correctly classified cases for a binary dependent variable model. It should be noted that the output of a logistic regression is not a classification as positive or negative, but a predicted probability of being positive or negative.

Stata command *estat classification* is used to obtain classification tables of sensitivities and specificities. In Stata, estat class uses a default probability of 0.5. Classification tables assess how many of the dependent variables’ observed values (1 or 0) have been correctly predicted.

As the estimation employs a mixture of continuous, ordinal and dichotomous variables, the following steps are carried out to obtain binary indicators for each of the models. First, all alternative indicators against which the MCES is tested in the validation exercise, are modelled as dichotomous dependent variables (Hoddinot and Yohannes 2002, Mogeni et al. 2011)[24]. Secondly, the *naïve estimate* (at the bottom of Table 5.20) is defined as the probability of being food insecure (value of the comparator measures equal to 1), without the introduction of the MCES in the model. Thirdly, five logistic regression models are estimated (between each comparator measure -HDDS, meals number, food sufficiency, wasting and stunting) where the MCES is introduced as a covariate. Then, the classification table is estimated. Finally, the values of the naïve hypothesis are compared and analysed against the correctly classified ones as an indication that the inclusion of the MCES in the model improves (or does not improve) the capacity of the regressions to identify food secure and food insecure households and individuals.

[24] Different threshold points are used to create dichotomous variables following the literature (for a review of the limitations of thresholds used for the HDDS see Chapter 3).

Table 5.20 Sensitivity and Specificity Analysis – correct classification rate for logistic model (Mozambique)

		Binary HDDS 1 if HDDS>=6* 0 if HDDS<6	Binary Meals_number** 1 if meals#>2 0 if meals#<=2	Binary Food_Suff 1 if HH is Food sufficient 0 if HH is Food insuffcient
Sensitivity	Pr(+ D)	95.54%	99.89%	12.91%
Specificity	Pr(-~D)	13.09%	0.29%	94.92%
Positive predictive value	Pr(D +)	63.71%	90.50%	63.46%
Negative predictive value	Pr(~D -)	64.77%	21.43%	61.44%
False + rate for true ~D	Pr(+~D)	86.91%	99.71%	5.08%
False - rate for true D	Pr(- D)	4.46%	0.11%	87.09%
False + rate for classified	+ Pr(~D +)	36.29%	9.50%	36.54%
False - rate for classified	- Pr(D -)	35.23%	78.57%	38.56%
Correctly classified		63.79%	90.41%	61.60%
Naïve Hypothesis		61.49%	90.48%	40.62%
		Binary wasting 1 if whz<=-2 0 if whz >-2	Binary Stunting 1 if haz<=-2 0 if haz >-2	
Sensitivity	Pr(+ D)	0.00%	1.11%	
Specificity	Pr(-~D)	100.00%	99.19%	
Positive predictive value	Pr(D +)	.	50.70%	
Negative predictive value	Pr(~D -)	93.22%	57.17%	
False + rate for true ~D	Pr(+~D)	0.00%	0.81%	
False - rate for true D	Pr(- D)	100.00%	98.89%	
False + rate for classified	+ Pr(~D +)	.	49.30%	
False - rate for classified	- Pr(D -)	6.78%	42.83%	
Correctly classified		93.22%	57.11%	
Naïve Hypothesis		6.78%	49.49%	

* The population mean (HDDS=6) is used as cut-off point to identify food secure and food insecure HHs.
** Meals number range: 0-4
*** Food sufficiency range: 1-3 (1: insufficient, 2: sufficient, 3:more than sufficient)
Source: Author, IOF 2008-09 data

Table 5.20 reports the results of the classification table for the five estimated models showing that overall, the introduction of the MCES in a logit model improves the correct classification and prediction rate of the models. The contribution is statistically significant and supports across the board positive increases in correct classification rates. For example, in the equation with the HDDS as dependent variable, the inclusion of the MCES increases the performance for sensitivity and therefore appears to be more helpful at identifying positive cases (HDDS=1 and therefore food secure). The equation relative to meals number illustrates similar patterns (better sensitivity power) and the classification remains virtually unchanged. In the case of food insufficiency, the use of the MCES improves the specificity performance (Food_suff=0 and therefore food insecure), also improving the correct classification.

5.6 Conclusions

Chapter 5 introduces the first MCES validation assessment. It provides a brief country profile of Mozambique, introducing the relevance of food prices in recent historical events and offering an overview of the state of food and nutrition security of the country. The validation employs the IOF 2008-2009 (HCES), and assesses the association between the MCES and a set of selected comparator measures of food and nutrition security and test the hypothesis framed in Chapter 3. The hypothesis states that increases of the MCES (as a result of food price surges and their relative income effect) are negatively associated with food and nutrition security indicators.

The validation assessment follows two steps: it first looks at the Pearson correlation coefficients as a preliminary step to evaluate the direction and strength of the association between the MCES and comparator measures of food and nutrition security; secondly it evaluates the association between the indicators of interest using a set of econometric estimators and the discussion of the results incorporates evidences from qualitative literature. Given the limitations listed and addressed within the capacity and framework of this work, the empirical analysis confirms the hypothesis and suggests that when the interaction between food prices and expenditure are incorporated and accounted for in a single indicator (like the MCES), this can provide a useful description of food price variation on poor household food and nutrition security.

The results from the first case study showed that the MCES is strongly associated with comparator measures that reflect the short-term consequences of household food and nutrition insecurity (i.e. household dietary diversity scores, meals frequency, household food insecurity and acute child undernutrition). This outcome suggests that the MCES can prove to be a useful tool to describe and monitor short-term effects of food price changes on household food and nutrition security and, with the use of ad-hoc and contexts specific analysis, can help identifying potential repercussions in term of individual nutritional status. Descriptive analysis on the seasonal patterns and household expenditure-related trends of the association between the MCES and food and nutrition security indicators reveal that there are strong patterns that follow expenditure distribution and seasonality. In particular, the severity by which the MCES is associated with the selected comparator measure is deeper at the end of the lean season and at the beginning of the main harvest. These findings are analysed by calculating correlation coefficients between groups and by looking at marginal effects for interaction terms in the statistical models presented. The overall picture suggests that seasonal patterns and tensions between food price fluctuations and expenditure shape food vulnerability.

Because the MCES incorporates food prices and household expenditure, it can offer a first indication of inter-household differences in reacting and absorbing food price shocks, monitor purchasing power of different income groups and signal critical situations (cyclical as well as unexpected) in a timely manner. It can represent an alternative approach to understand the impacts of seasonality on agricultural production, price fluctuations and income generation activity at the localized level. A better picture of the said interaction and can improve the understanding and (possibly help) the prevention of severe effects on the nutritional status of poor population in low and middle income countries.

Chapter 6 MCES validation 2 - Estimates for Bangladesh

Introduction

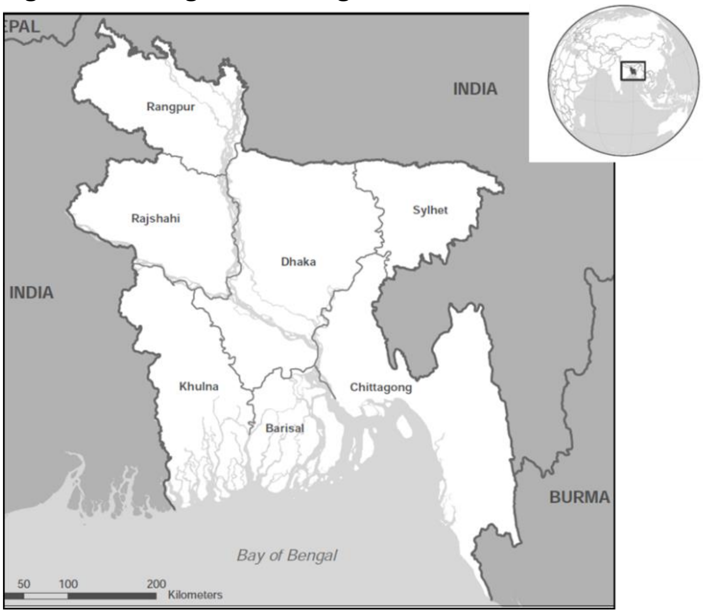
During the initial stages of the empirical analysis outline, it emerged that the use of two case studies that depicted different agro-ecological and food consumption patterns while sharing similarities in terms of food and nutrition security problems, would be beneficial in evaluating the value of the MCES as a food measurement tool. This chapter aims at providing additional insights to the MCES micro-validation and attempts to further the discussion introduced in the previous Chapter. Therefore, the following sections offer an additional micro-validation assessment that uses Bangladesh (2008-2009) as its case study.

Like its previous *companion chapter* (Chapter 6), this section provides a profile of Bangladesh with a focus on its agricultural system and overall food security and nutrition status. The country profile section ends with a description of the food riots exploded during the 2008-09 food price crises. The chapter then continues with describing the data and the main food and nutrition security indicators used in the micro-validation assessment. After a brief review of the methodological approaches (that are more thoroughly described in Chapter 4), the chapter presents results and their discussion. Finally, the chapter closes with presenting the outcome of the robustness checks.

6.1 Country profile – Agriculture and Nutrition in Bangladesh

Bangladesh is a lower-middle income country situated in South Asia, characterized by an economy that has experienced significant economic growth over the past decadesand that is expected to remain resilient in the future (World Bank 2016).

Figure 6.1. Bangladesh at a glance



Sources: DHS 2013

Per capita income increased exponentially since independence in 1971, from a GDP per capita of 132 (current) USD in 1971 to 1212 USD in 2015 (WDI 2017)[1]. Likewise, aggregate poverty levels witnessed significant reduction as the country made progress towards successfully achieve most of the MDGs[2] (UNDP 2015). However, declining poverty rates have not spread in a uniform way and Bangladesh still experiences pervading levels of inequality (UNDP 2005). Arable land reduction, increasing sea levels and persistent flooding coupled with extreme climatic conditions represent threats to food and nutrition security (FAO 2016). In particular, rural population and urban slums dwellers have been left behind in the poverty alleviations endeavour and remain the most vulnerable categories to climatic and economic shocks (Scott-Villiers et al. 2016).

In the past decades, the Bangladeshi economy has been characterized by a growth of the manufacturing sector –Table 6.1. Although over the years the agriculture has decreased as percentage value added to the GDP, this sector is still pivotal to the country, as it employs almost half of its labour force (IFAD, 2016). Agricultural production mostly occurs on relatively small family farms and takes place over multiple cropping seasons(Headey and Hoddinott

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[1] http://data.worldbank.org/indicator/NY.GDP.PCAP.CD?locations=BD accessed on 26 January 2017

[2] The Human Development Index (HDI) value for Bangladesh in 2014 was 0.570. This value positions the country in the Medium Human Development category (ranking it 142nd out of 188 countries). Bangladesh's HDI score grew from 0.338 to 0.570 between 1980 and 2014, with an annual growth rate of about 1.55% (UNDP 2015).

2016)[3].However, in rural areas the majority of the poor are landless farm labourers and smallholder farmers for whom rice production is vital, because it accounts for around 70% of their calorie intake and is one of the fundamental labour sources for unskilled workers. (Balagtas et al., 2014; Hossain et al. 2005, Ravallion, 1990).

Table 6.1. Bangladesh's GDP sectoral shares between 1980 and 2014

	1980	1990	2000	2010	2014
Agriculture value added (% of GDP)	31.6	32.8	23.8	17.8	16.1
Industry value added (% of GDP)	20.6	20.7	23.3	26.1	27.6
of which Manufacturing	13.8	12.6	14.7	17.0	17.0
Sevices value added (% of GDP)	47.8	46.6	52.9	56.0	56.3

Source: World Bank Development Indicators (2017) – accessed 26 January 2017

Besides being an important crop for most of the vulnerable segment of the population, rice is the main agricultural product of Bangladesh and represents 61.5% of total production in the sector (FAO 2017)[4]. The exponential increase of rice production (rice production grew 95% between the 1990s and 2014 (FAO2017)) is largely due to the use of High Yield Variety (HYV) crops, introduced with the Green revolution together with irrigation infrastructure and fertilizers (Hossain et al. 2005).This resulted in a significant rise in yields and annual crops, coupled with a gradual engagement in the liberalisation of the agricultural and food market (Wiggins 2010). The heavy political and economic efforts to reach self-sufficiency in rice production during the 80s was a response to the dramatic events that placed Bangladesh at the epicentre of one of the most devastating famines of recent history. In 1974, 1.5 million people perished as a result of the civil war with Pakistan, which was followed by a series of natural disasters (Hossain et al. 2005, Sen 1981, Seaman & Holt 1980)[5].In view of these dramatic events, the essence of food security objectives establishes the need to reach autonomy of rice production and price stabilization (Dorosh et al. 2004).

Despite high potentials in agriculture and growth in the industrial and services sector, Bangladesh has one of the most uneven distribution of wealth and around half of the population lives in absolute poverty (IFAD 2014). Food production is susceptible to adverse

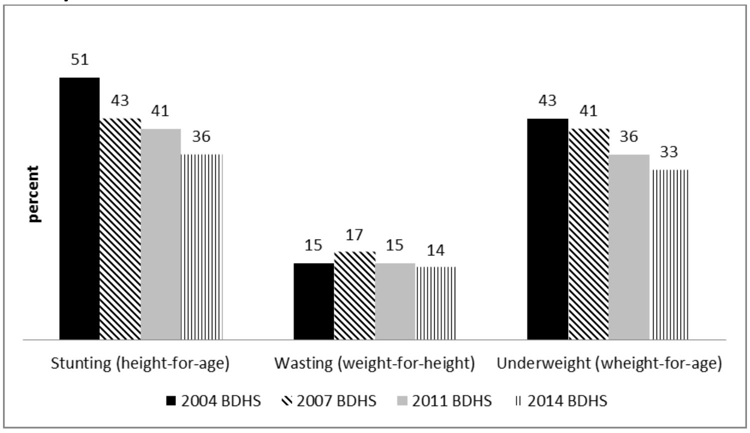
[3] Rice production, takes place in three different seasons: early-monsoon low-yielding aus rice season (April to July); direct-seeded deep-water aman rice (March- November); and high-yielding boro rice crop (January to June) (Hossain et al. 2005).

[4] Other important agricultural crops produced in Bangladesh include: potato, vegetables, fruits, wheat and pulses.

[5]This study acknowledges that to provide a full picture of the causes that triggered the famines in 1943 and 1974 a literature review on the colonial era' and its legacy will be needed. In addition, an in depth description of the famines would also benefit the understanding of the nature of the Bangladeshi government responses to the 2008 food crisis. However, this goes beyond the scope of this research.

weather conditions and according to the FAO and WHO (2014) one-third of households face significant food insecurity. Even though in the past years there has been a general improvement in undernourishment levels[6] and child nutritional status, 36% of children under five were stunted, 14% suffered from acute undernutrition and 33% were undernourished in 2014 (Figure 6.2). According to the latest DHS (2014), chronic undernutrition among children under 5 year of age was higher in rural areas than urban areas, with 38% of rural children being stunted compared to 31% of urban children. Conversely, acute malnutrition affected 14% of rural and urban children under five.

Figure 6.2 Trends in nutritional status of children under five years old in Bangladesh (2004-2014)



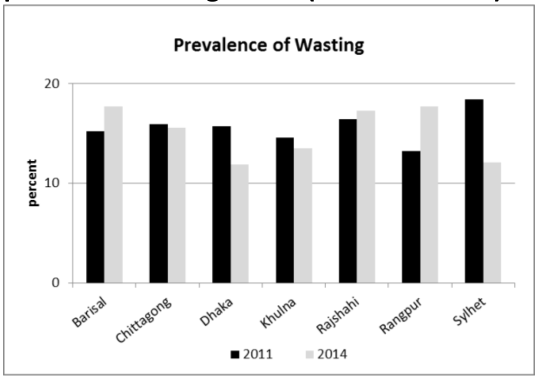
Source: DHS 2016

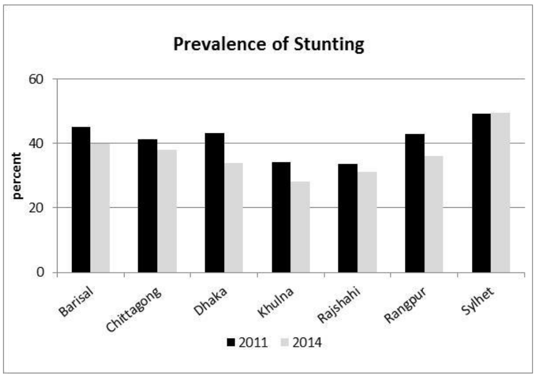
Figure 6.3 6.3 illustrates child undernutrition prevalence at the provincial level between 2011 and 2014, revealing that improvements in nutrition levels touched the country in an uneven way. While the prevalence of stunting has consistently decreased between 2011 and 2014 in most of the provinces (with the exception of Sylhet, in the north east of Bangladesh), figures on the prevalence of wasting offers a different picture, with some of the poorest provinces (Barisal, Rangpur and Rajshahi) exhibiting a substantial increase with average rates between 1% and 5%[7] in three years.

[6] In 2015Bangladesh achieved the MDG target 1 reducing its undernourishment levels (measure in PoU – prevalence of undernourishment)from34.6% in 1990-92 to 16.8% in 2010-2012 (FAO and WHO 2014).

[7] FAO and WFP report (2014) identifies the following regions of Bangladesh as the most food insecure: northeast part of the country as they are located in river flood plains, cycloneprone areas in the southern coastal belt and the south-eastern part of the country.

Figure 6.3 Prevalence of wasting and stunting among children under 5 years of age in the provinces of Bangladesh (2011 and 2014)



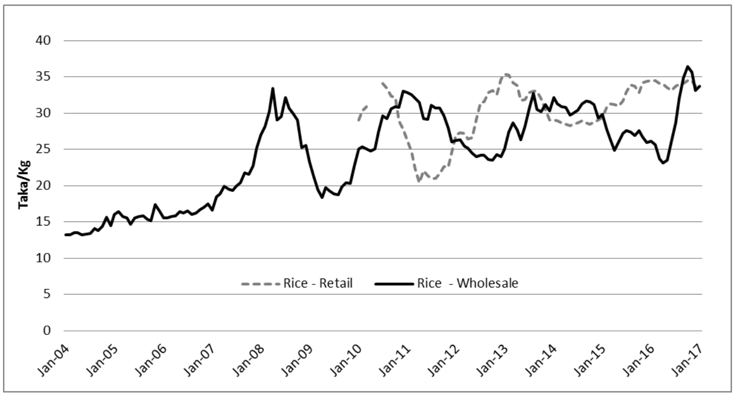


Source: DHS (2013, 2016)

6.2 Food Riots in Bangladesh

High poverty and undernutrition levels transformed the 2008-2009 food price crisis to the preamble of severe suffering and deep repercussions in terms of nutrition and health among large strata of the population. Increases of global food prices in 2007 and 2008 generated sharp rise of staple prices in Bangladesh (Raihan 2013, Sulaiman 2009). In particular, domestic rice prices almost doubled between 2005 and 2008 (from an average of 14 Taka/Kg in 2004 to 27.5 Taka/Kg in 2007 and 2008) (Figure 6.4). In the same year, Bangladesh was hit by the Cyclone Sidr, causing substantial damages to the aman rice crop[8]. Moreover, the country also heavily suffered from the rice export ban set by India (Bangladesh's main rice supplier) that further exacerbated the effects of international food price increases on domestic markets. In June 2008 wholesale prices plunged reaching almost 18.50 Taka/Kg a year later in April 2009, but by the end of that year they started a steady rise which are still observed in 2016.

Figure 6.4 Rice Price Trends in Bangladesh



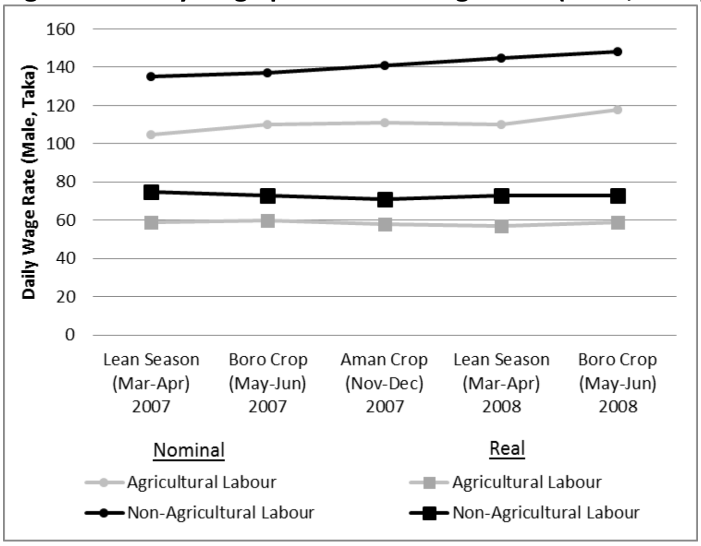
Source: FAO, Food Price Monitoring and Analysis Tool (2017) - Accessed 26 January 2017

[8] Bangladesh has three rice harvests: Aman crop, June–October; Boro crop, running December to April-June harvest; and the smaller Aus crop, between March-August (FAO/WFP 2008).

Increased price levels were only marginally counterbalanced by increments of wages. Although figures show incomes increases of approximately 12% between 2005 and 2008, estimates for real income reveal that they had actually eroded by almost the same amount (12%)in the same time span (WFP et al. 2009).

Figure 6.5 illustrates the daily pattern of agricultural and non-agricultural wages (nominal terms- with round marker, and real terms– with a squared marker) in Bangladesh between March 2007 and June 2008. The figure shows that while nominal wages increased, real wages remained unchanged due to widespread inflation. In addition, while the agricultural and non-agricultural nominal wages are substantially different (with non-agricultural wages significantly higher than the agricultural ones[9]), real terms wage rates are almost convergent, signalling higher inflations in urban areas.

Figure 6.5 Daily wage patterns in Bangladesh (Male, Taka) – Nominal vs Real terms



Source: GoB Bangladesh Bureau of Statistics in WFP et al. 2009

Purchasing power sensibly eroded, especially because of food price increases. Prior to the crisis (first half of 2007) the average wage of labourers could buy five to seven kg of rice per day of work (WFP et al. 2009). One year later, the same salary could only purchase 3.5 to 5 kg of rice. This dramatic drop of basic food purchasing power meant that less income was devoted to non-food expenditures and, especially for the poorest, less desirable and smaller quantity of food were consumed.

[9]Alongside the rural – urban differentiation in wage rates, gender discrimination in labour remuneration are very persistent. In the agricultural sector daily wages of women can worth 75% of men wages, and in the non-agricultural sector women can receive as little as 50% of men daily wages.

Bangladesh was one of the countries that experienced food riots in early 2008 in the context of other demands related to the labour rights and minimum wage increases. The most notable event was a demonstration in Dhaka attended by ten thousand workers demanding higher pay over the fast-increasing food costs (Hossain and Jahan 2014). Police responded with opening fire and using batons and tear gas to disperse the crowd (Chaube 2008 in Schneider 2008).

Different segment of the population where negatively affected by high and fluctuating food prices, including those that traditionally would benefit from price increases. For example, small family farmers were unable to benefit from price rises due rising input costs and fewer resources to buffer against price shocks. Poor urban consumers, who are generally heavily dependent of food markets for their survival, could not protect themselves due to their high share of expenditure on food purchase (Hossain 2014). In the short term not only poor households but also middle-income families that relied on fixed wages (for example civil servants, nurses and teachers) experienced a deterioration in their purchasing power(Wiggins 2010). The large body of evidence on the effects of food price volatility in Bangladesh (Martin 2009, World Bank 2012, Rashid et al.2012, Levay et al. 2013 and Hossain and Jahan 2014) analyses the livelihood adaptation strategies that households were obliged to implement to survive, bearing high costs in terms of food intake and health. Coping strategies included cutting consumption, substituting for lower quality foods and less diverse diets, cutting meals and their frequency during the day (Jahan et al. 2015). A study by Balagtas et al. (2014) estimated that the sudden food price spikes of 2007-08 pushed 13 million people residing in rural Bangladesh into poverty, suggesting that shocks can have devastating effects on the poor as well as on households that are positioned at the edge of poverty.

The following section of the chapter describes the main comparator indicators that will be used to assess the MCES validity for the Bangladesh case study[10].

6.3 Data Description

This section provides an overview of the data employed for the analysis. It first presents a snapshot of the MCES (6.3.1) and subsequently summarizes the main features of the

[10]A full description of the data and survey that is used can be found in Chapter 3.

comparator measures of food and nutrition security[11] employed in the micro-validation (6.3.2). The section concludes by briefly discussing staple food expenditure patterns in Bangladesh and restating the importance of food purchase of food and staple food (6.3.3).

6.3.1 MCES: calculation and main features

As in the previous case study, the household level MCES calculated for Bangladesh is the variable of interest in the analysis and expresses the share of the household expenditure required to purchase a portion of energy requirement. The MCES calculated for Bangladesh only includes rice, which represents the main staple food in the Bangladeshi diet (on average it represents almost 50% of staples consumed by Bangladeshi households). Equation 6.indicates the formal specification of the indicator, that calculates household level MCES at the monthly level:

Equation 6.1

$$MCES = \frac{\sum_{i=1}^{n}((P_{rice}\ /K_{rice}) * HHminKcal_i) * month}{HHmonthly\ consumption\_exp_i}$$

The MCES includes monthly *upazila*[12] level prices (Taka per Kg) of rice and because it incorporates only one staple product, there is no weighting system applied. Average monthly rice prices are subsequently divided by rice calorie density, to obtain the market price of one Kcal of rice. A representative Food Composition Table for Bangladesh (Shaheen et al. 2013) is used to convert rice prices expressed in Kg into Kcal. Finally, the daily cost to meet household's minimum calorie requirement (expressed in adult equivalent terms) is calculated by multiplying the price of one calorie of rice to $HHminKcal_i$, where the latter is defined as 60% of the minimum energy requirement of the household[13]. After obtaining the monthly minimum calorie expenditure, the calculation of the MCES concludes by dividing the numerator by household monthly consumption expenditure.

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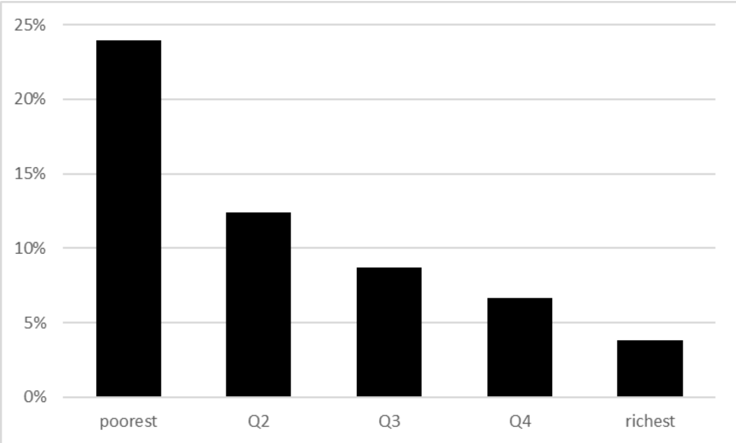
[11]i.e. Household Food Consumption Scores, Self-Assessed Food Insufficiency information and child anthropometric measures.

[12]Upazila refer to geographical regions in Bangladesh and they function as sub-units of districts.

[13] 60% represent the average value of rice on the total value of consumption of staple foods (discussed in section 5.3.3).

Figure 6.6 illustrated the distribution of the MCES values over the expenditure quintiles[14]. Unfortunately, due to the relatively short survey period (with data collected only between November 2008 and January 2009), monthly fluctuations of MCES do not provide substantial variation from which interpretations can be derived.

Figure 6.6 MCES for Bangladesh – Breakdown by expenditure quintile



Source: Author, from BHFSNA (2009) data.

Although the average values of the MCES do not exhibit critical percentages, meaning that the minimum expenditure for rice purchase does not dominate most of the household expenditure (the values range from 24% to 4%), the MCES can offer valuable insights on the varied ways by which the interaction between prices and income differ between and within expenditure groups. The figure above shows that poorer households need to devote, on average, almost 25% of their monthly expenditure to purchase a proportion of household minimum energy requirement if they were buying only rice (one of the cheapest option for calories). The MCES drops sharply for other expenditure groups that need on average between 12% and 4% of their household expenditure to purchase staple food that corresponds to the household minimum energy requirement. Data collection coincided with the harvest season of *Aman* rice (especially the transplanted variety), which is the most important rice crop of the country. *Aman* rice makes up almost half of the rice cultivated land, followed by *Boro*and *Aus* (Zaman 2003). Due to the significant crop injection in the market, prices started to decrease and remained low until the end of 2009 (Figure 6.4).

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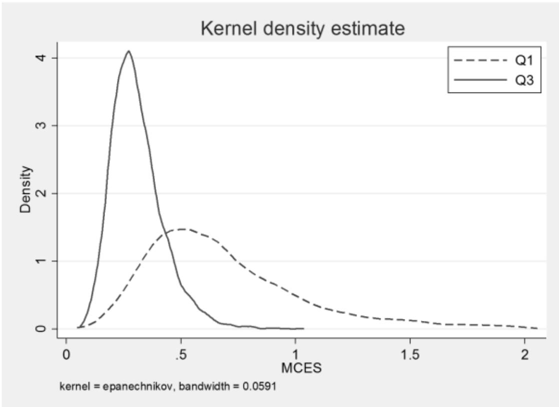
[14] Due to a number of missing monthly household expenditure and implausible values both for prices and expenditure, 70 observations could not be used. The MCES ranges between 0.7% and 1.99%

As per the initial expectations, the association between the MCES and expenditure groups is negative. Finally, Figure 6.7 shows the distribution of the MCES for the poorest expenditure group compared with the median expenditure (Q3). While the MCES of median expenditure group appears to be less dispersed and skewed towards lower values of the indicator, poorer households experience a wider range of MCES outcomes, mainly shifted towards the right-hand side of the graph. Because prices are common through the distribution, the factor defining the variability of the MCES is the denominator. Poorer households not only exhibit lower expenditures but they also experience a wide range of variability of their disposable incomes.

Figure 6.7 MCES within expenditure group dispersion



Source: Author, from BHFSNA (2009) data

6.3.2 Overview of comparator measures of food and nutrition security

This sub-section presents the main features of the main comparator measures of food and nutrition security used to analyse the validity of the MCES using the data for Bangladesh. The description starts by outlining the trends of the household Food Consumption Scores (FCS), it continues with information on Self-Assessed Food Insecurity (SAFI) and it concludes describing the estimates on child anthropometrics[15]. The discussion covers general features of the indicators (that include rural-urban and provincial differences) before focusing on patterns and trends based on households' expenditure distribution and seasonality. Income distribution and seasonality are recurrent themes across the thesis and represent crucial features that have informed the conceptualization of the MCES.

[15] The reader may consult Chapter 3 for the characteristic and the selection criteria of these indicators

Household dietary diversity is examined through the **Food Consumption Score** determined through a series of questions on the type and number of food items consumed with a 7-day recall. Food items are categorized in nine food groups: Cereals and Tubers; Pulses; Animal proteins (meat, fish, eggs); Vegetables; Fruits; Dairy; Sugar; Oils and Fats; and Condiments[16].

Table 6.2

Table 6.2 illustrates the average FCS for the total sample as well as reporting average disaggregate figure by expenditure quintile and rural-urban location. The mean level of the FCS is 58.8 and population in urban areas benefit from a more varied diet compared to those residing in rural areas. The FCS scores improve as income increases. More specifically, for lower income groups, FCS scores are higher in rural areas, and they improve more rapidly for urban areas as income increases.

Table 6.2 Food Consumption Scores by expenditure group and location

All	Mean	Min	Max
FC_Score	58.8	0	112
	(21.1)		
[redacted]			
Urban	64.2	(22.4)	
Rural	55.8	(19.6)	
Expenditure group	All	Rural	Urban
Poorest	44.6	45.0	43.0
	(17.3)	(17.4)	(16.9)
Q 2	50.9	50.7	51.4
	(17.1)	(16.8)	(18.1)
Q 3	57.4	57.1	57.9
	(18.0)	(17.8)	(18.3)
Q 4	65.1	63.1	67.4
	(19.5)	(19.2)	(19.5)
Richest	76.0	71.4	80.3
	(21.0)	(20.2)	(20.8)

Mean FCS ANOVA:
rural-urban difference p<0.001
expenditure group difference p<0.001
Standard deviation in parenthesis

Source: Author, from BHFSNA (2009) data.

Although there is no recognized threshold for evaluating alarming values of dietary diversity scores, this thesis follows the guidelines suggested by WFP for the context that is under analysis. The BHFSNA Report uses four "increased" thresholds to assess the FCS in Bangladesh (Table 6.3 6.3). Elevated thresholds are introduced to include the importance of oil and fish in

[16] The calculation of the FCS follows WFP guidelines (WFP 2008). A description of FCS methodology can be found in Chapter 4 (Section 4.2).

the diet of the Bangladeshi population (WFP et al. 2009). Average FCS scores for the poorest population are situated at the lower limit of acceptable food consumption category; almost one-quarter of the sample (23.6%) reports poor or borderline FCS values with approximately 5% falling in the poor food consumption group.

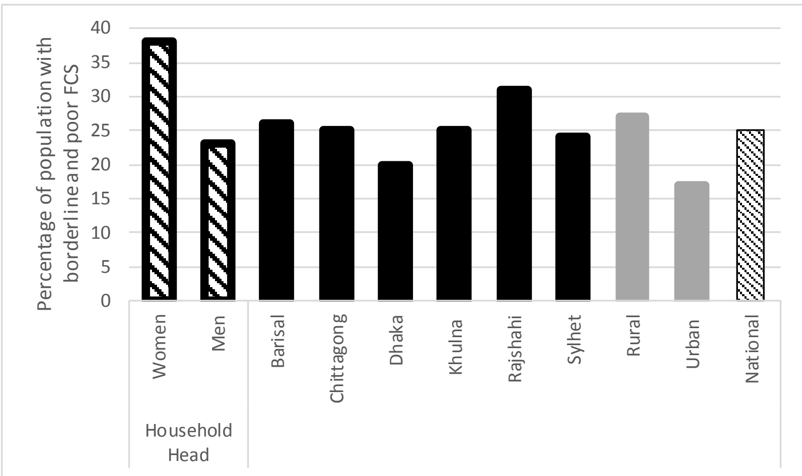
Table 6.3 Threshold definitions for FCS assessment

Poor consumption	<= 28
Borderline Consumption	>28 and =42
Acceptable Consumption (Low)	>42 and =52
Acceptable Consumption (High)	>52

Source: WFP et al. (2009)

Figure 6.8 illustrates in more detail the characteristics and geographical distribution of low FCS scores. Households that are women-headed are those that lead the food insecure group, with 38% of them having either inadequate or borderline FC scores. Rural population appear to be over-represented in this group (27%), however, as seen previously, the bifurcation between urban and rural occurs for higher income groups as well. The picture provided by the FCS on the distribution of food insecurity, illustrates that food insecure population is mostly prevalent among rural households, regardless of their expenditure level. In urban areas, households suffering from food insecurity are mostly represented among poorer income households. Rajshahi and Barisal are the most food insecure divisions according to the FCS (a finding that is in line with previous studies that identify these provinces among the most food insecure of the country (WFP et al. 2009), while other divisions match the national average or have lower scores.

Figure 6.8 Low and borderline FCS scores: Prevalence of food insecure population.



Mean FCS ANOVA: Women-Men difference and division difference statistically significant (p<0.01). Source: Author, from BHFSNA (2009) data.

The diet of the households with low diet diversity is dominated by staples (manly cereals and coarse rice), vegetable and edible oil. They rarely consume meat, poultry and fish and in their diets products such as pulses, dairy products and fruit never appear. Both acceptable consumption score groups consume more animal protein products on a more frequent basis, but even households' diets with *acceptable low* FCS are relatively poor in dairy and fruits. Only households with *acceptable high* food consumption scores consume all food groups and on a more frequent basis. This description depicts a clear picture of the minimum common denominator components in the diets of households in Bangladesh: edible oil, cereals and vegetables.

Household Self-assessed Food Insecurity (SAFI) includes three types of information:

1) The number of meals eaten by adult members of the household in the 24h prior to the interview (1 to 7)
2) The number of meals eaten by children (1 to 5 years) of the household in the 24h prior to the interview (1 to 7)
3) Household Food Insufficiency(i.e.havingexperienced food insecurity) over the 12 months prior the interview (yes/no). If yes, in which months?

Information from these questions is used to complement the description on food security provided in the previous section. Table 6.4illustrates the number of meals eaten by adult members and children (the day prior to the survey), grouped over different domains: FCS groups, household head sex and urban-rural distinction. Considering a threshold of 3 meals a day as an optimal number of meals for an adult person, on average, only adults in food secure (high acceptable consumption category) reach the said threshold, while other groups consumed are likely to consume a marginally suboptimal number of meals. A benchmark for child meals frequency for children are more complex to set, as the information ought to be combined with age, breastfeeding status and type of food (complementary feeding or nutritious snacks such as a piece of fruit, bread or chapatti with nut paste) (Dewey 2003)[17]. In

[17] Dewey (2003) indicates: *"The appropriate number of feedings depends on the energy density of the local foods and the usual amounts consumed at each feeding. For the average healthy breastfed infant, meals of complementary foods should be provided 2-3 times per day at 6-8 months of age and 3-4 times per day at 9-11 and 12-24 months of age, with additional nutritious snacks (such as a piece of fruit or bread or chapatti with nut paste) offered 1-2 times per day, as desired. Snacks are defined as foods eaten between meals-usually self-fed, convenient and easy to prepare. If energy density or amount of*

addition, guidelines are normally defined for children up to 24 months. Therefore, figures on child meals in Table 6.4 are to be treated as a preliminary indication of food security. Approximately all households provide food to their younger members four or more times per day with some notable exceptions, such as poor food consumption group and households with women heads.

Table 6.4. Breakdown of number of meals taken per day by adults and children

	Number of meal eaten by adult	Number of meal eaten by children (1-5Y)
	average	average
FCS group		
Poor consumption	2.7	3.7
Borderline Consumption	2.9	4.0
Acceptable Consumption (Low)	2.9	4.1
Acceptable Consumption (High)	3.0	4.3
Household head		
Woman	3.0	4.2
Man	2.9	3.9
Area		
Rural	2.9	4.1
Urban	3.0	4.2

Mean FCS ANOVA: FCS group difference p<0.01, Women-Men difference p<0.01, Area difference p<0.01
Source: Author, from BHFSNA (2009) data.

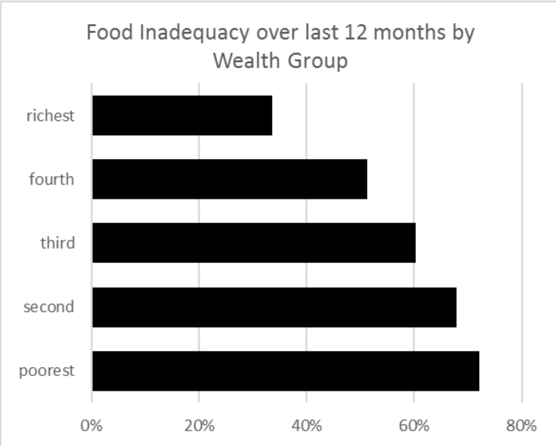
Similar figures can be seen for the breakdown of meal frequency by expenditure quintile (Table 6.5). While for children there is a fairly homogenous meal frequency across expenditure groups, it is important to highlight that 10% of adults in poor households consumed only 2 meals the day prior to the interview. Indeed, it looks like having a higher income tends to ensure higher quantities of meals per day; right panel of Table 6.5 illustrates how higher income alleviates food insufficiency. Over 70% of poor households report that they did not have enough food to eat at least once over the past 12 months before the survey. Rates of food inadequacy stay relatively high also for the second and the third expenditure groups, and

food per meal is low, or the child is no longer breastfed, more frequent meals may be required" (Dewey 2003, p. 21). Conversely, the indicator minimum meal frequency (MMF) is used for infants aged 6 to 23 months. Minimum meals frequency calculates the proportion of breastfed and non-breastfed children of the said age group who also consume solid, semi-solid or soft food (WFP et al. 2009). MMF corresponds to: 1) two times and three times for breastfed infants 6-8 months and 9-23 months respectively; 2) four times for non-breastfed children from 6 to 23 months *(ibid.)*

decrease for the better-off families (65.6%). However, almost 35% of rich households report some form of food insufficiency during 2008. The questionnaire does not incorporate questions on the causes of food insufficiency, but one could infer that this high percentages of food insecurity among richer households could be due to the global and national food price and financial crisis that occurred between 2008-2009.

Table 6.5. Meals Stability, food inadequacy and expenditure quintile

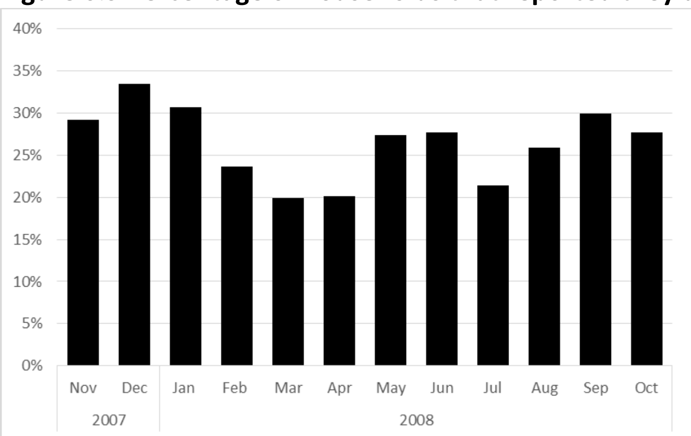
		Expenditure Quintile				
		poorest	second	third	fourth	richest
				%		
# of meals eaten yesterday (**adults**)	1	1.1	0.3	0.3	0.1	0.1
	2	11.0	7.6	5.2	3.4	1.7
	3	86.9	91.4	93.1	94.7	93.1
	more	0.9	0.7	1.4	1.7	5.0
# of meals eaten yesterday (**children**)	1	2.9	2.1	1.6	1.2	2.6
	2	3.9	3.0	2.2	4.0	3.2
	3	33.8	33.4	34.0	32.3	31.2
	4	27.0	29.5	26.6	24.8	24.2
	5	18.7	18.4	19.7	21.1	20.1
	6	8.9	7.7	9.5	9.0	9.4
	7	4.7	5.9	6.5	7.5	9.3



Percentage differences between expenditure groups are statistically significant (Anova F $p<0.01$)
Source: Author, from BHFSNA (2009) data.

Over half of the interviewed households (56%) have experienced forms of food insufficiency in the 12 months before the survey. Among these households, most indicate that the most critical period lies between September to January (Figure 6.9), a period corresponding with the lean season before the aman harvest, precarious months for the livelihood and food security of many poor Bangladeshi households (Zug 2006).

Figure 6.9 Percentage of households that reported they did not have enough food by month



Source: Author, from BHFSNA (2009) data.

Unfortunately, due to the short time frame of the survey, it is not possible to draw a comprehensive picture of seasonal food insecurity beyond this section. However, the discussion and the conclusion to the chapter engage with the literature on seasonality, integrating this analysis within a bigger narrative about seasonality and food security in Bangladesh.

Nutritional estimates conclude section 6.3.2.These indicators are examined for children[18] under the age of 5, via anthropometric measures such as weight-for-height z-scores (4002 children), height-for-age z-scores (3931 children) and weight-for-age z-scores (4175 children)[19]. The analysis also includes MUAC for children and mothers as a further indication of acute under nutrition. In the following section prevalence of the said anthropometric measures is analysed within different dimensions: geographical dimension, children age groups and household wealth. As in the previous case study, WHO 2006 growth reference standards are used to calculate z-score of the said nutrition measures (WHO 2006).

Table 6.6 reveals a critical scenario of child undernutrition in Bangladesh, with prevalence figures for all indicators above or very close to the WHO emergency thresholds (i.e. 15% for wasting, 40% for stunting and 30% for underweight) (WHO 1995b). Wasting appears to be particularly critical in the divisions of Barisal and Rajshahi, figures that are somehow consistent with the previous findings on food consumption scores. The divisional overview of chronic undernutrition shows that all figures exceed the 40% threshold, with Sylhet and Dhaka having the highest percentages of stunted children. Sylhet appears to be the leading division also in terms of prevalence of child underweight together with Barisal. In terms of rural and urban distinction, children residing in rural areas are more likely to suffer from the three different manifestation of undernutrition considered, compared to their urban counterparts, especially as regards to stunting (50.4% in rural areas compared to 45.4% in urban areas) and underweight (38.3% for rural areas and 34.3 in urban areas). However, beyond any geographical distinction, these figures exemplify a critical situation in the whole country.

[18] Girls to boys proportion ranged between 0.9 and 1.1 across all age groups and anthropometric measurement, and equal to 1 in the total sample (WFP et al. 2009).

[19] Hereafter we will use the following acronyms for the three anthropometric indicators weight-for-height z-scores (WHZ), height-for-age z-scores (HAZ) and weight-for-age z-scores (WAZ)

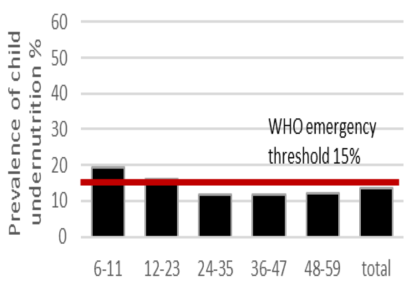
Table 6.6 Prevalence of child (6-59 months) undernutrition by location

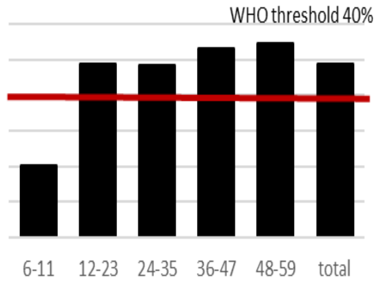
	Wasting	Stunting	Underweight
		%	
Barisal	16.1	49.4	42.3
Chittagong	13.4	49.6	41.7
Dhaka	12.3	51.3	36.9
Khulna	12.4	401	29.6
Rajshahi	15.2	44.2	33.8
Sylhet	13.5	56.6	42.8
Anova test for % z-score <-2	*p<0.01*	*p<0.01*	*p<0.01*
Rural	13.8	50.4	38.3
Urban	12.4	45.4	34.3
Anova test for % z-score <-2	*p<0.01*	*p<0.01*	*p<0.01*
Bangladesh - National	13.5	48.6	37.4

All figures represent Global Undernutrition measures (<-2 Z-score)
Source: Author, from BHFSNA (2009) data.

Figure6.10 illustrates the prevalence of the undernutrition measures by age group (6-59) months. The most vulnerable group to acute undernutrition are young children (from 6 to 23 months) a common pattern, as children are introduced to complementary foods within these months. A specular picture is associated to stunting and underweight that tend to affect older children as chronic undernutrition develops over a longer period of time and can include determinants other to food.

Figure6.10 Prevalence of child undernutrition by age group



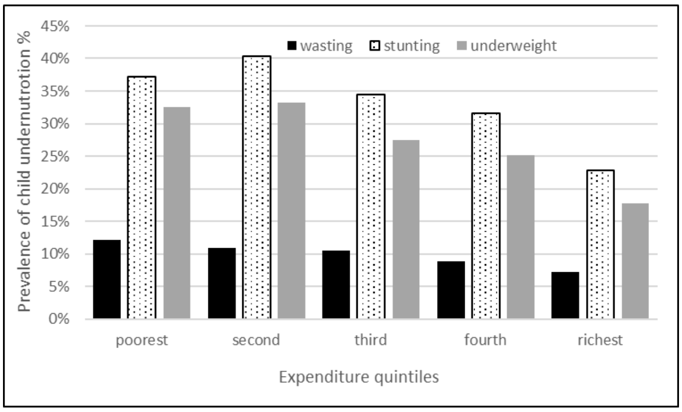


Wasting **Stunting**

All figures represent Global Undernutrition measures (<-2 Z-score).Percentage differences between age groups are statistically significant (Anova F p<0.01).
Source: Author, from BHFSNA (2009) data.

Figure 6.11 shows the breakdown of child undernutrition measures by expenditure quintiles. Although at different rate, the prevalence of the three undernutrition measures decreases as income increases, suggesting once again that, among other dimensions, income plays an important role in determining the occurrence of undernutrition. Despite a trend illustrating a decrease in undernutrition rates towards the richest quintiles, generally these rates are concerning and suggest that undernutrition levels are critical within all wealth groups.

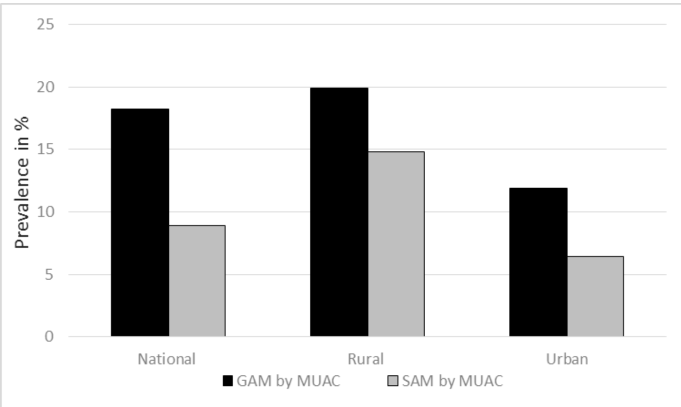
Figure 6.11 Prevalence of child undernutrition by expenditure group



All figures represent Global Undernutrition measures (<-2 Z-score).
Percentage differences between expenditure groups are statistically significant (Anova F $p<0.01$)
Source: Author, from BHFSNA (2009) data.

Mid-upper arm circumference data on 3852 mothers (of children between 0 and 59 months) and from pregnant women, have been used as the proxy of acute malnutrition among Bangladeshi women between November 2008 and January 2009.The cut-off point of less than 221 mm[20] informs that the prevalence of global acute undernutrition is 18.2%. The prevalence of severe acute malnutrition (that uses the cut-off measure of 214mm) is 8.9%.

Figure 6.12 Prevalence of maternal GAM and SAM (by MUAC) – national average and area breakdown



Percentage differences between types of area are statistically significant (Anova F $p<0.01$)
Source: Author, from BHFSNA (2009) data.

Indicators on food and nutrition security were concerning for Bangladesh in 2008. Almost one quarter of the sample exhibited poor or borderline food consumption score, with households headed by women and those residing in rural areas overwhelmingly represented. Child undernutrition was critical especially in terms of stunting and underweight, while prevalence

[20] Cut-off points based on WHO recommendations (WHO 1995b)

of global acute malnutrition was only marginally above the critical emergency level set by WHO (WHO 1995b). In relation to the household's area of residence, rural locations held higher percentages of child undernutrition (for all indicators) and maternal wasting. This is not to say, however, that urban settings exhibit less problematic food and nutrition insecurity issues. Previous literature has explored the relationship between undrenutrition and poverty in rural areas, stating that it does not improve in urban settings, due to the difficulties in accessing land and reliance to food markets (Fotso 2006). In both rural and urban environments, the interaction between food prices and income remains crucial in determining household purchasing power. The next session explores food expenditure patterns of Bangladeshi households, emphasizing the importance of food and staple purchase over different types of household groups.

6.3.3 Staple food expenditure patterns in Bangladesh

In Bangladesh food accounts for a large share of the total household expenditure. On average, almost 62% of the total household expenditure is devoted to the purchase of food[21]. The poorest quintile spends proportionately more on food (71%) than the national average, and urban and rural households exhibit similar food budget shares that coincide with the national figures (Table 6.7).

[21] Under the umbrella of "food", the following items are included: staples (rice, wheat, other cereals, potato and pulses), vegetable, edible oil, milk, meat, fish, condiments, fruit and sugar and others.

Table 6.7 Staple budget shares- Bangladesh (Nov2008-Jan2009) - National, rural and urban, expenditure quintiles

	% Share of food in total value of food				% Share of staple basket in total value of			
Households	All	Poorest	Rural	Urban	All	Poorest	Rural	Urban
Average values	61.69	71.05	62.07	61	38.69	40.20	38.87	38.36

	% Share of staple foods in total value of consumption of main staples			
	Rice	Potato	Pulses	Wheat
All	62.23	13.69	7.76	3.15
Urban	51.73	25.43	13.49	8.86
Rural	46.04	33.17	16.73	3.45
Expenditure Quintile				
Poorest	68.27	20.32	9.04	1.91
Q2	85.03	16.19	8.46	2.59
Q3	71.87	14.32	8.20	3.38
Q4	56.74	12.12	7.91	4.04
Richest	34.27	7.31	5.62	3.55

Source: Author, from BHFSNA (2009) data.

The mean share of staple foods over the total food budget is approximately 40%, making this food group the largest within the food budget. Rice is the main staple food of Bangladesh, and it is eaten on average two times per day alongside with vegetables and fish (Jennings et al. 2014, McIntyre et al. 2011, Tetens 1998). Nationally, 62% of the staple budget is dominated by rice purchase. This figure peaks to 85% for households in the second expenditure group, followed by families in the third expenditure group (71%). The share of rice purchase over total consumption of staple food prices for the first expenditure quintile is 68%, diverging with what commonly in expected, namely an opposite movement between income and staple food expenditure. Previous studies on ultra-poor households in Bangladesh revealed a hand-to-mouth life, lacking of subsistence food and primary goods and services and dependent on irregular incomes (McIntyre et al. 2011, Frongillo et al. 2009). This could suggest that rice is inaccessible to lower income households that purchase very little rice and rely on other sources of calorie acquisition, if any.

For affluent families, rice represents 34% of the total value of staples expenditure and rice purchase relative to total household expenditure is high across all expenditure groups. Middle-income households can be adversely affected by price swings; their situation might not be a permanent food insecurity state, but fluctuations of prices of food and other important goods can destabilize their food security and push them into poverty over certain period of time, with detrimental effects on the nutrition status of household members (Balagtas et al. 2014).

To further reinforce the assumptions of the importance of food purchase (and therefore food prices) for all expenditure groups, Table 6.8 illustrates the different sources of food acquisition of Bangladeshi households[22]. Regardless of location and expenditure group, food purchase (from local market or other source) is the main source of food acquirement. Surprisingly, rural households rely on food purchase to a greater extent compared to their urban counterparts. Poorer households engage in production of their food more than other expenditure groups. However, this percentage is minimal and 90% of food derives from the market. Previous literature on food security of very poor and marginalised households in Bangladesh shows that even when households engage in own-production of food and small livestock rearing, these products are rarely consumed (McIntyre et al. 2011). Other cheaper foods are preferred (rice *in primis*) in order to feed all family members and secure food for subsequent meals.

Table 6.8 Food acquisition strategies in Bangladesh – figures from BHFSNA2008-09

	Area			Expenditure Group				
	All	Rural	Urban	Poor	2nd	3rd	4th	Rich
					%			
Food purchase *(local market and other locations)*	94.4	92.9	80.9	90.0	94.2	95.3	95.3	95.3
Own production	4.5	5.9	16.2	7.1	4.6	4.0	3.5	3.7
Food aid	0.3	0.3	0.4	0.8	0.3	0.1	0.2	0.1
Food debt	0.2	0.2	0.2	0.4	0.3	0.2	0.1	0.1
other (work, gift, barter)	0.7	0.7	0.6	1.7	0.6	0.4	0.4	0.3

Source: Author, from BHFSNA (2009) data.

6.4 Approaches and results of the micro-validation

Following the structure of the previous chapter, this section first present the control variables used in the empirical models (6.4.1) followed by a brief description of the methodological steps followed to assess the association between the MCES and food and nutrition security comparator indicators (i.e. Food Consumption Scores (FCS), child and maternal anthropometric measure and household Self-Assessed Food Insecurity (SAFI)). The presentation and the discussion of the results are presented together and the section concludes with presenting and discussion the interaction terms between the MCES and food and nutrition security comparator measures over expenditure group.

6.4.1 Control variables

Similarly to Chapter 6, this section defines the control variables used in the empirical strategies adopted in the second stage of the MCES validation. The literature on the relationship

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[22]BHFSNA Report produced by WFP et al. (2009) includes information on sources of food acquisition (own consumption, purchase, food aid, debt and other).

between food security and food price shocks informs the selection of the confounding variables for FCS and SAFI indicators, while the literature on the effects of food price changes on nutrition informed those for child and maternal anthropometrics. First the control variables for the FCS and SAFI indicators are describes, followed by those pertinent to the child and maternal anthropometric measures. The equations described in Chapter 4 and used in the MCES validation, are listed below (with the original equation numbering) for the reader's convenience.

Equation 4.14

$$FCS_h = \alpha + \beta_1 MCES_h + \beta_2 \boldsymbol{P} + \beta_3 \boldsymbol{HH} + \beta_4 \boldsymbol{PA} + \beta_5 \boldsymbol{L} + \boldsymbol{\varepsilon}$$

Equation 4.10

$$Ln\, Pr(SAFI_j = i) = ln\, \alpha + \beta_1 MCES_h + \beta_2 \boldsymbol{P} + \beta_3 \boldsymbol{HH} + \beta_4 \boldsymbol{PA} + \beta_5 \boldsymbol{s} + \beta_6 \boldsymbol{L} + \boldsymbol{\varepsilon}$$

Equation 4.11

$$WHZ_{ih} = \alpha + \beta_1 MCES_h + \beta_2 \boldsymbol{P} + \beta_3 \boldsymbol{C} + \beta_4 \boldsymbol{HH} + \beta_5 \boldsymbol{WS} + \beta_6 \boldsymbol{s} + \beta_7 \boldsymbol{L} + \boldsymbol{\varepsilon}$$

Equation 4.12

$$HAZ_{ih} = \alpha + \beta_1 MCES_h + \beta_2 \boldsymbol{P} + \beta_3 \boldsymbol{C} + \beta_4 \boldsymbol{HH} + \beta_5 \boldsymbol{WS} + \beta_6 \boldsymbol{s} + \beta_7 \boldsymbol{L} + \boldsymbol{\varepsilon}$$

Equation 4.13

$$MUAC_{ih} = \alpha + \beta_1 MCES_h + \beta_2 \boldsymbol{P} + \beta_3 \boldsymbol{HH} + \beta_4 \boldsymbol{WS} + \beta_5 \boldsymbol{s} + \beta_6 \boldsymbol{L} + \boldsymbol{\varepsilon}$$

Prices of important non-staple commodities and competing foods are important to determine the purchase of other substitute and complementary foods. Drawing from D'Souza and Joliffe (2013a, 2013b) analytical approach, the models isolate the effect of changes of the MCES on food and nutrition security indicators, prices of edible oil and pulses[23] (vector$\boldsymbol{P}$) are included in all equations . These prices are collected at the *upazila* level and the vector incorporates monthly averages by *upazila*. Lentils (to cook daal) are an important source of proteins for households in Bagladesh (Alam 2016). Poorer households would normally opt for lentils when additional resources are available as a side dish to the main rice course[24].Oil is an integral part

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[23]The database includes prices of three variety of lentils: poor, medium and high quality. Prices of poor quality lentils are lower compared to the other better qualities. Because the lower quality is likely to be the variety consumed by poorer households, the micro-validation includes the low quality lentils prices to control for variations of this important food's price.

[24]In their qualitative study on food provisioning experience amongst the ultra-poor female headed households in Bangladesh, McIntyre and colleagues (2011) describe the daily food routine followed. They find a "hierarchy" amongst the foods that are consumed which is dictated by resource availability and affordability of products. The

of Bengali cuisine and its affordability is crucial to the possibility and frequency of cooking (Jennings 2014, Frongillo 2009)[25].

Vector $\boldsymbol{HH}$ includes information on the household structure, housing characteristics and productive assets. It includes measures of household size, dependency ratio, and age, gender, education level, marital status, whether the household receives food aid and employment status of the household head. The latter is included as an indication of income stability. This binary variable distinguishes between stable and unstable (seasonal) employment. Relying on a stable and adequate source of income is amongst the main factors that can determine the ability to absorb shocks and ensure the quality, quantity and frequency of food intake over time (McIntyre 2011, Zug 2006). The same vector incorporates livestock ownership (distinguished between small, medium and large animals), and cultivation of fields and gardens. The latter two are employed to control for own production of food which is an important source of food intake. Literature on homestead cultivation suggests that agricultural strategies, such as home gardens, can contribute to more diverse diets for young children and women, and contribute to maintain adequate levels of food security (Girard 2012).

Vector $\boldsymbol{PA}$ denotes a set of variables measuring the physical accessibility to dietary variety. Similar earlier research illustrated that improved market access have positive association with household diet diversity (Snapp and Fisher, 2014). Binary variables on village road quality (poor and not poor) and lack of transportation means at the village level are introduced to control for this factor.

Finally, vector $\boldsymbol{L}$ includes variables for the household location in terms of rural or urban areas and their division of residence to control for any geographical variation. Due to the relative short period represented in the survey data, the variable on seasonality is not included in the micro-validation of the MCES for Bangladesh.

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majority of interviewed women rely on a basic subsistence diet of rice or potato cooked with salt. When additional resources make it possible chillies, leafy vegetables, pulses and dried fish are purchased and added to the main starchy course.

[25]Frongillo et al. (2009) analyse alternative ways of understanding the experience of household food insecurity in rural Bangladesh and identify nine themes that express its various manifestations: meals (frequency), cooking (possibility and frequency), rice (affordability), fish (affordability), perishable foods (affordability), snacks (frequency), and management strategies (food borrowing and debt). The question related to cooking possibility and frequency asks how many times a day (in the past 30 days) did cooking take place in the household. The affordability of the main ingredients (such as oil) as well as fundamental elements to prepare meal (i.e. fuel) are critical for assuring that cooking takes place regularly and it is possible.

Similarly to the OLS used for the FCS and ordered logistic models for the SAFI indicators, a vector of variables on edible oil and pulses prices is included ($\boldsymbol{P}$) as well as the variables included in the $\boldsymbol{HH}$vector, used in the estimation of the MCES association with child and maternal anthropometrics.

The models with child anthropometrics also include measures of child characteristics, grouped in vector$\boldsymbol{C}$**.** These variables include age group (in months), sex and birth order of the child. Information on the health status (i.e. oedema) as well as intake of specific supplements(i.e. vitamin-A) and whether the child is being currently breastfed are introduced to control for well documented factors that can hinder/improve child growth and nutrition (Lutter, 1989). Unfortunately, the dataset does not provide personal information for household members other than the household head, reason for which vector $\boldsymbol{M}$ is missing from the equations above. The model relative to **MUAC,** does not include variables relative to mother's age, education, employment or marital status. It accounts for breastfeeding, if the associated child has been breastfed the day prior to the interview.

Finally, given the importance of safe water and access to hygienic toilet facility on nutrition and health of children and adults (Curtis et al. 2004, Rahman 1985), a binary variable measuring the availability of water for the household (and its quality) and measures for the quality of toilet facilities (vector $\boldsymbol{WS}$) are added. Table 6.9 summarizes the control variables so far described.

Table 6.9 Dependent (in italic) and control Variables

Variable Name	Variable Description	Measurement
FCS and SAFI		
FCS	*Food Consumption Score*	*0-112*
meals_num_adults	*Meals number eaten by adults the day prior the interview*	*1-7*
meals_num_children	*Meals number eaten by children the day prior the interview*	*1-7*
Food Insufficiency	*Household Food Insufficiency (i.e. having experienced food insecurity) over the 12 months prior the interview*	*0:No/1:Yes*
edible_oil_price	Edible oil prices (Taka/litres)	Average price by upazila[26]
daal_low_price	Lentil (daal) prices – low quality variety (Taka/Kg)	Average price by upazila

[26]Upazila refer to geographical regions in Bangladesh and they function as sub-units of districts.

hhsize	Household (HH) size	Number of members in the household
dependency_ratio	Dependency ratio	Number of dependents(0-14 and over the age of 65) to the total population, aged 15 to 64.
Sex	Sex of the head of the HH	0:Female / 1:Male
Age	Age of head of the HH	Age in years
Educ	HH head literacy	0 Never attended or No class completed 1: Class I to Masters degree
empl_status	Employment Status	0: unstable or casual employment 1: stable employment
M_status	Marital Status	0: Married 1: Widowed, Divorced, Separated, Never married.
garden_cultiv	Regular cultivation of a home garden	0:No/1:Yes
field_cultiv	Regular cultivation of field	0:No/1:Yes
large_livestock	Ownership of large size livestock	0:No/1:Yes
medium_livestock	Ownership of medium size livestock	0:No/1:Yes
small_livestock	Ownership of small size livestock	0:No/1:Yes
Lack_transp	Lack of transport means in the village	0: Means of transport not accessible 1: Means of transport accessible
Poor_road	Road conditions in the village	0: Poor road conditions 1: Good road conditions
area	HH area of residence	1:Urban/0:Rural
Division	HH division of residence	Barisal, Chittagong, Dhaka, Khulna, Rajshahi, Sylhet
Food_aid	Share of food from food aid	0 – 100%
Anthropometric Measures (Stunting and Wasting)		
WHZ1	*Weight-for-height z-score*	*From -5 to 5*
HAZ1	*Height-for-age z-score*	*From -6 to 6*
MUAC_Mother	*Maternal middle-upper arm circumference*	*In cm*
child_sex	Sex of the child	0:Boy / 1: Girl
age_group	Child age group	<6:1/ 7-11:2/12-23:3/24-35:4/36-47:5/48-59:6
BO	Birth Order	1 to 5
Milk_yest	Child has received breast milk the day prior the interview	0:No/1:Yes

Vitamin_A	Child has received vitamin A during past 6 months	0:No/1:Yes
oedema	Child has bilateral oedema	0:No/1:Yes
Improved_sanitation	HH has improved sanitation facilities	0:No/1:Yes
Safe_water	HH drinks piped water or treats the water before drinking	0:No/1:Yes
Toilet	Type of toilet facility	0: not improved (eg. Pit latrine, buckets, bush, fields) 1: improved (eg. piped to sewer system, flush)

6.4.2 Setting the hypothesis, results and discussion

Once more, it is worth spending some words to remind the objective of the MCES validation process and its central hypothesis. The MCES calculates the minimum energy expenditure, defined as the cost of a minimal calorie requirement from staple foods (considered the cheapest and most effective calorie option), as a share of the household total consumption expenditure (comprised of food and non-food). Values of the MCES are higher for low-income households and lower for households with higher incomes. The hypothesis tested in the validation exercise (based on the theoretical framework described in Chapter 3) is that increases of the MCES have detrimental effects on food and nutrition security indicators. Therefore, it is expected that the correlation coefficients and the estimate coefficient β_1(in Equations 4.5, 4.10 to 4.14) are negative.

The section describes the results in the following order:

- Calculation of Pearson correlation coefficients (an index showing the extent to which two variables are correlated with each other) between the MCES and the set of food and nutrition security indicators used for the micro-validation;
- Ordinary Least Squares regressions to estimate the relationship between the FCS (treated as dependent variable) and the MCES;
- Ordered Logistic regressions to estimate the relationship between variables on adult and child meals frequency[27] (treated as dependent variable) and the MCES.

[27]In particular, the variable refers to the number of meals eaten in the day preceding the interview by adults and children.

Unfortunately, due to unsuccessful trials with food insufficiency status, the variable is not included in this stage of the analysis;

- Ordinary Least Squares regressions to estimate the relationship between the MCES, child wasting, stunting (by WHZ and HAZ respectively) and maternal wasting by MUAC.

A thorough explanation of the estimators is provided in the chapter dedicated to the methodological approach for the micro-validation (Chapter 3).

- *Results of the Pearson Correlation Coefficients.*

Pairwise (Pearson)correlation coefficient between the MCES and food and nutrition security indicators are reported in Table 6.10 an. As in the previous chapter, Bonferroni adjustment is appliedto control for the family-wise error rate (Shaffer 1995).The first column illustrates the correlation coefficient for the whole sample, and the following block looks at the correlation between MCES and food and nutrition security indicators by expenditure group. Since data collection was carried out during one season, seasonal comparison is not applicable.

Table 6.10 Pairwise correlation analysis between MCES and food and nutrition security indicators

	Aggregate	Expenditure group (in quintile)				
Indicator		Poorest	Q2	Q3	Q4	Richest
Diet diversity indicator						
FCS	-0.309***	-0.157***	-0.257***	-0.275***	-0.304***	-0.315***
Self-Assessed food insufficiency						
N of meals (Adults)	-0.135***	-0.074**	-0.161***	-0.092***	-0.086***	-0.125***
N of meals (Children)	-0.065***	-0.025	-0.086	-0.030	-0.093	-0.166***
Food insufficiency (over past 12 months)	0.161***	0.039	0.080***	0.149***	0.131***	0.179***
Anthropometric indices						
Child Wasting (by WHZ)	-0.023	-0.121***	0.428***	-0.209***	-0.098**	-0.028
Child Stunting (by HAZ)	-0.059***	-0.044	0.189***	-0.179***	-0.171***	-0.014
Maternal Wasting (by MUAC)	-0.139***	-0.008***	-0.232***	-0.232***	-0.266***	0.157***

Bonferroni-adjusted significance - Significance level: * p < 0.1. ** p< 0.05. *** p< 0.01.
Source: Author, from BHFSNA (2009) data.

At the aggregate level, regardless of the food and nutrition securityindicator against which association is evaluated, the analysis shows a negative and significantcorrelation between the MCES and alternative food and nutrition security measures. This is true except for the food insufficiency variable, which is positive, because it reports affirmative values in case the household experienced food insufficiency in the past 12 months. It is interesting to note that as was the case with the first study discussed in Chapter 5, the negative correlationbetween the MCES and the dietary diversity indicator adult meals number and positive correlation with household food insufficiency, is stronger compared to the correlation observed for the child anthropometrics measures. The association between the MCES and maternal wasting is negative and statistically significant.

The Pearson correlation coefficient between the MCES and FCS is also negative and statistically significant (p-value<0.01) across all expenditure groups and the negative correlation becomes stronger as household expenditure increases. This suggest that, when facing higher food prices, household will make considerable adjustments to their diet composition to maintain adequate levels of calorie intakes. The figures suggest however, that households at the top of the expenditure distribution could be experience substantial declines in their dietary diversity.

With regards to the SAFI indicators, correlation coefficients for household food insecurity and both number of meals consumed by adult and children confirm the hypothesis. While the number of meals eaten by adults appears to be more “responsive” to the MCES, the correlation coefficient linked to the meals consumed by children lower with the predictive power being concentrated in the correlation coefficient relative to the richest households. The correlation pattern between MCES and SAFI indicators across expenditure groups somehow indicate that the MCES is more sensitive to the effects of food prices at the top of the expenditure distribution, where correlation coefficients between the MCES and the three SAFI indicators exhibit higher significance levels and magnitudes.

The association between MCES and anthropometric measures is negative but not significant for child wasting (by weight-for-height z-score). Variation across expenditure group suggest that the MCES is more sensitive to child wasting for poorer households, as the coefficients decrease both in magnitude and significance level as expenditure increases. Child chronic undernutrition and maternal wasting (by MUAC) are both significantly negatively correlated with the MCES (p-value<0.01) and their correlation with the MCES over expenditure groups tend to weaken for low expenditure groups. With regards to stunting, the correlation coefficients hint to an association between MCES and lagged effects of long-term undenutrition. As previously noted, child stunting is a result of factors that go beyond food intake.

Thanks to the inclusion of maternal wasting in the survey, the analysis for the Bangladesh case study can shed some light on the effects of food price changes on adult nutritional status. Analysis on the nutritional impact of the Indonesian crisis show that maternal wasting appeared to be more sensitive to the crisis (de Pee et al., 2001). These and other similar studies suggest that child wasting and other anthropometric indicators are not always sensitive indicators of the effects of economic or price crisis situations, as maternal wasting is(Kiess et al.2000). With the exception of the correlation coefficient between MCES and maternal stunting for the richest expenditure group, the correlation between these two indices is negative and statistically significant, exhibiting a stronger correlation for better off households. This preliminary analysis on the correlation figures at the aggregate level suggest that indicators that reflect short term effects of food prices crisis, such as dietary diversity and maternal wasting, appear to be more sensitive to changes of the MCES. When the correlation between indices is analysed over different expenditure groups, mixed results are produced in terms of magnitude and statistical significance, indicating in some of the cases weaker levels of correlation between the MCES and the comparator measure for lower expenditure groups and stronger for richer households. On the one hand, this might be due to the fact that households in lower economic positions, have their food consumption already pushed to the cheapest items, with little possibility to substitute expensive with cheaper foods. On the other hand richer households might have more room for manoeuvre to adapt their dietary intake in face of higher food prices.

It is worth reminding again, that given the several limitations of this technique, the preliminary analysis of the correlation coefficients serves to confirm some initial hypothesis regarding the association between the MCES and more widely used food and nutrition security indicators. The next section looks at each of these associations and refining the methodological approaches to analyse the direction and trends of these associations.

- Estimates from the Econometric Analysis

Findings on the association between the MCES and food and nutrition security indicators are presented in Table 6.11. The discussion of the results blends in the presentation of the estimates and engages with debates initiated by both quantitative and qualitative studies. In particular, to substantiate the discussion, food consumption patterns of poor households analysed with qualitative analysis are integrated to this section. The discussion then moves on by looking at the interaction between the MCES and expenditure quintile. Unfortunately, due to a relatively short period of data collection, this case study of Bangladesh does not provide a seasonality dimension to the analysis.

Regardless of the estimation strategy and indicator (with the exception of child wasting) the estimated coefficients are negative and highly significant ($p\text{-value}<0.01$).

Table 6.11. MCES and the Food and Nutrition Security indicators - association at the household level[a]

Estimator	Outcome indicator	MCES coefficient
	Diet Diversity Indicator	
OLS	FCS	-27.16***
		(7.314)
	SAFI	
Ordered Logistic[b]	N. of meals - adults	-1.536***
		(0.514)
	N. of meals - children	-1.343***
		(0.398)
	Child Anthropometry	
OLS	Child Wasting (by WHZ)	0.112*
		(0.0577)
	Child Stunting (by HAZ)	-0.392***
		(0.0777)
	Adult Anthropometry	
	Maternal Wasting (by MUAC)	-3.865***
		(1.479)

Robust standard errors in parentheses. Significance level: * p < 0.1. ** p< 0.05. *** p< 0.01.
[a] Full results provided in Appendix G.
[b]Coefficients of Ordered logistic models expressed in odds ratio.
NB: The estimations use the confounding factors reported in Table 6.9 and discussed in section 5.4.1 of this chapter.
Source: Author, from BHFSNA (2009) data.

The estimate of the first model, assessing the relationship between the MCES and household FCS indicates that fluctuations of the MCES are negatively and significantly associated (p-value <0.01) with variations of the household food consumption scores. This suggests that increases of the MCES could reduce household dietary diversity (measured in FCS) in Bangladesh. For example, qualitative analysis conducted by Sulaiman and colleagues (2009) in the aftermath of the food price increases provides additional insights on how food consumptions was impacted by the 2008 food price increases. Meal composition was significantly affected by the 2007-2008 food price crisis. Interviewed households consumed less food and of fewer varieties. While rice was consumed both before and after the crisis, items such as fish and lentils were purchased in smaller qualities in order to maintain the consumption of these foods in the daily intake[28]. Moreover, the consumption of milk, meat, eggs and fruit was irregular also during the pre-crisis period and after the crisis they were excluded from meals. Households substitute

[28] Before the food crisis, interviewed households reported that they consumed big or small fish on a daily basis. However, after the crisis they could only afford less expensive species (*Pangas*) or dry fish. Consumption of dal remained stable in terms of frequency but cheaper variety (such as black gram or *mash koli*) took the place of more expensive ones (*mosur*) (Sulaiman et al. 2009).

gathered vegetables to purchased ones, use of chilli and salt increased to add flavour to food of a lower quality or add water to increase the volume of the curry (Jahan et al. 2015, Ruel 2010, Sulaiman et al. 2009).

The SAFI variables are used as ordinal dependent variables (Allendorf 2007) in maximum likelihood ordered logistic models. The odds ratios from the ordered logistic model can be interpreted as the factor by which a unit increase in the MCES variable (and all other independent variables) will affect the odds of being in a higher or lower category of the SAFI indicators. Estimates for these trials conform to prior expectations, and show a negative and significant association (p-value <0.01) between the MCES and number of meals consumed (by both adults and children). The results suggest that, when controlling for confounding factors, meals frequency for both adults and children can be negatively impacted by purchasing power deterioration as measured by the MCES. For those whose primary expenditure is mainly devoted to food, cutting costs in the short term due to food price increases means eating less (Jahan et al. 2015). It is worth signalling that this initial finding does not indicate how meals reductions are distributed within the household. This changes based on the economic status, location of the household, and the ability to rely on support systems from social networks. For example, some literature suggests that during periods of food shortages or economic difficulties, households will tend to provide the principal income earner with foods that are high in energy and more abundant meals (Ruel 2010).

Finally, child and maternal anthropometric measures show a negative and statistically significant association (p-value<0.01) for child stunting (by HAZ) and maternal wasting by (MUAC) while the model returns a positive and significant coefficient (p-value<0.05) for child wasting (by WHZ). While the first two results are in line with initial hypotheses, the latter could raise some questions. Two factors could be causing this. Firstly, it can be assumed that child wasting calculated with anthropometric measure collected during the final months of 2008 and beginning of 2009 (almost a year from the sharp food price increases) are unrepresentative of acute undernutrition. Secondly, as previously noted, there is a strand of nutrition literature that suggests the use of different anthropometric measures to analyse the effects of food price changes on nutrition security (such as child anemia and vitaminA deficiency disorders and adult anthropometric measures) (Kiess et al. 2000).

The regression coefficient relative to maternal wasting is negative and statistically significant (p<0.01) implying that together with young children there are other vulnerable groups (in this case mothers, but also adolescents, elderly and ill members of the household) whose nutritional status can be affected by purchasing power deterioration but for whom data is seldom available. In general, some families buffer high food prices in various ways (greater work efforts or by cutting adult's food consumption) and maintain real food consumption levels especially for children (Miller and Urdinola, 2010).

Interaction Effects with Expenditure

Similarly to the previous chapter, marginal effect graphs are used to visually present the effect of an interaction term between the MCES and expenditure distribution (expressed in quintiles) over the different food and nutrition security comparator indicators.Margin refers to a statistic computed from the predictionof a modelwhile manipulating the values of its covariates (Jann 2013). Marginal effects refer to differences in levels of margins if covariate values are changed (i.e. survey quarter and expenditure level) while all other variable are kept constant (at their mean level).This method helps providing additional information on the association between the MCES and other food and nutrition security indicators, using for example, expenditure levels to proxy the economic status of the households.

The graphs depicted in Figure 6.13 illustrate the predicted value of each dependent variable on the Y axis given the MCES value on the X axis, broken up over households expenditure groups (expressed in quintiles). The negative (positive) slope of a curve indicates negative (positive) associations between the dependant variable and the MCES.The degree of the curve's concavity, indicates the strength with which changes in MCES are reflected in changes in the indicator used as the dependent variable.

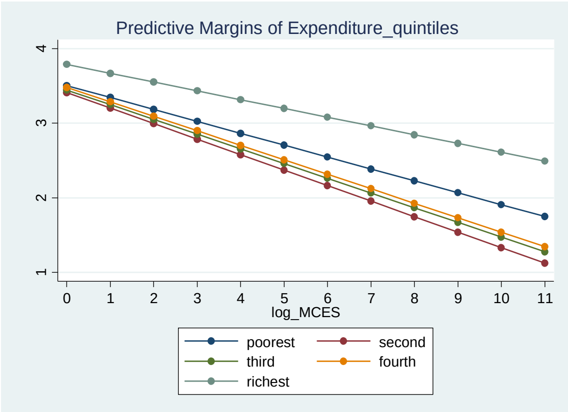
The figures show that the potential impacts of the MCES on different indicators of food insecurity and degradation of the nutritional status varies over expenditure levels. For example, the negative association between MCES and food consumption score appears to be more inelastic for the highest expenditure group followed by the lowest one. The negative association for the expenditure groups in the middle of the distribution are more prominent. While the results for the poor and richer households are similar, the underlying causes could be different. On one hand, richer households may be able to buffer their dietary diversity thanks to higher income availability, and therefore are less affected by the MCES variations. On the other, poor households response to variations of the MCES appear to be inelastic, because their dietary diversity could be already pushed towards poor and monotone diets with little room to adjust their food consumption towards cheaper items. The interaction term is significant (p-value < 0.01)[29], indicating that the differences among the expenditure levels are significant. The two SAFI indicators, reporting the number of meals consumed by adults and children (the day prior the interview) indicate a similar pattern. The negative association between the MCES and number of meals consumed by adults and children is more prominent for poorer households. While adults meals number for higher expenditure group is noisier, the association between the MCES and children meals number becomes gradually inelastic as expenditure increases.

The estimates relative to the MCES and anthropometric associations, are graphically illustrated in Figure 6.13 (positive for child wasting (by WHZ) and negative for child stunting (by HAZ) and maternal wasting (by MUAC)). The negative association varies across expenditure levels with the first expenditure quintile being severely affected. While this work considers these measures valuable indicators, it also recognizes that interpretation of results in relation to price fluctuations can be incomplete. Some of the issues have been described in Chapter 4, Chapter 6, and in the previous section, indicating that child anthropometrics may not represent the ideal indicators of short-term impacts of food price variations. Unaffected child anthropometric indices may hide coping strategies that can be detrimental to the nutrition and health status of other family members, fuelling the malnutrition-poverty cycle and leaving the household more vulnerable to future shocks.

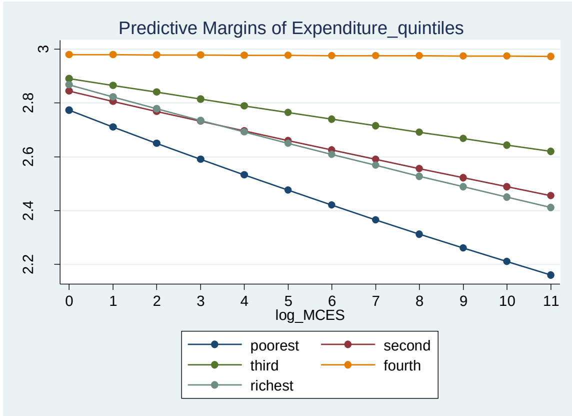
[29] Full diagnostic tables available in Appendix G

Figure 6.13. Marginal Effects graphs: interactions between the MCES and expenditure quintiles for the food and nutrition security indices

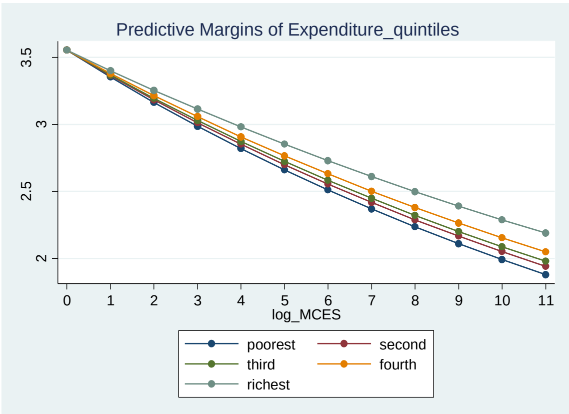
Food Consumption Scores



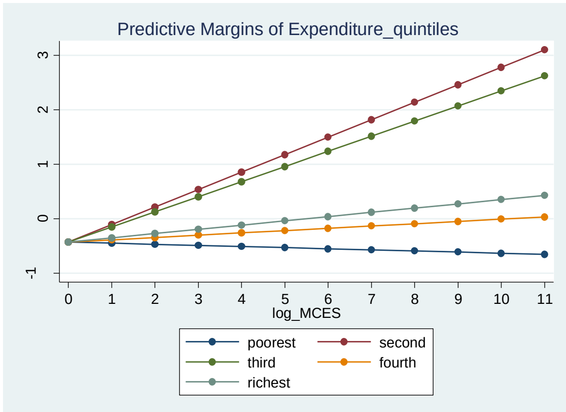
SAFI1-Adults Meals Number



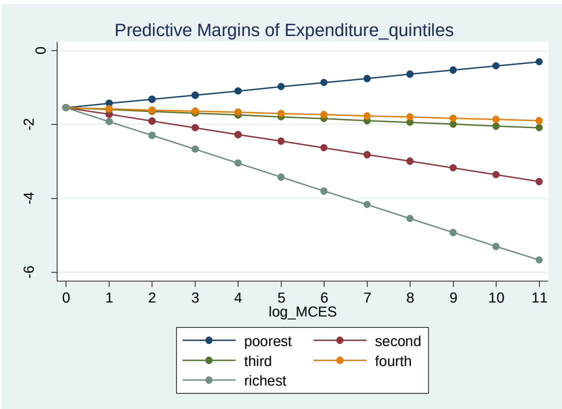
SAFI2-Children Meals Number



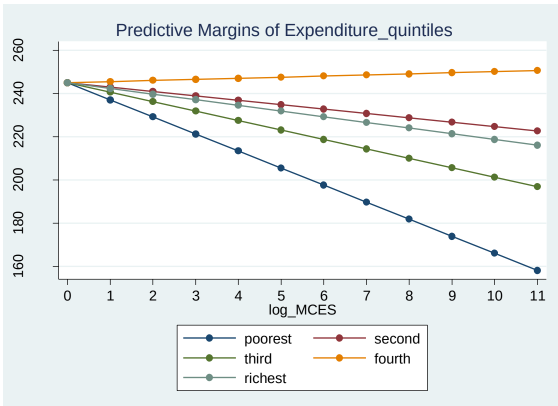
Child Wasting (by WHZ)



Child Stunting (by HAZ)



Maternal Wasting (by MUAC)



Source: Author, from BHFSNA (2009) data.

Due to a relative short time-frame of data collection, BHFSNA 2008-2009 data only covers three months' worth of information, giving little room for thorough analysis on seasonal patterns of food and nutrition security in Bangladesh. However, seasonal fluctuations are pronounced in the country, and especially in rural areas it is common to observe significant frictions between income generation activities and food availability (Zug 2006). In areas where agriculture is the main source of employment but simultaneously very dependent on agricultural cycles and are vulnerable to climate related shocks, such frictions can hinder the livelihoods of many (Ahamad et al. 2011). In particular, *monga* or seasonal hunger, is a well-known phenomenon in the rural areas of Bangladesh. It encompasses different dimensions of food insecurity, including the absence of employment and income opportunities for rural poor in the period between transplantation and harvest of paddy. As described by Zug (2006) this factors are exacerbated by dysfunctions in the local social systems such as lack of accountability in land administrations and colliding interests of local authorities, national government and non-governmental organizations.

Limitations

Similarly to the Mozambique case study, models and data limitations have been encountered in the Bangladesh empirical analysis. The relationship among prices, expenditure, food intake and nutrition can suffer by simultaneity and endogeneity as the correlation between these variables could be bidirectional (Deaton 1997). Again, single cross-sectional and single period household surveys can produce biased estimates. For this particular case study, several concerns derive from missing not at random (MNAR) data. This is partly due to the fact that the dataset was received already with a high degree of data cleaning manipulation . On the one hand, a number of indicators and cleaning were computed to the author's advantage, but on the other, the underlying data was not available. Most importantly, personal information are only present for the household's head. For example, control variables for maternal wasting model unfortunately do not include age, education level and health status of the respondent. The pattern of missing data has been carefully explored and the analysis deals with MNAR by inferring missing observation with similar ones (e.g. missing prices are estimated as monthly average of neighbouring villages or district level). A similar strategy to Chapter 5 has been adopted, and missing food prices have been imputed based on monthly averages by upazila level. The analysis was performed with and without imputed prices, leaving the results mosntly unchanged.

This thesis attempts to evaluate the validity of the MCES methodology, by using standard tools of empirical economic analysis, employing available secondary data sources and opting for models that better capture the nature of the dependant variables. All models are assessed for goodness-of-fit, violation of regression assumptions and for presence of multicollinearity. Estimates use standard Huber-Whitecorrection to estimate the sampling variance, whichallows forcorrelation of the residuals within divisions and multicollinearity checks reveals that this is not a problem for most of the control variables as the calculated variance inflation factors (VIF) are below the threshold of ten.

As mentioned in the section that discusses the limitation of the empirical analysis in Chapter 5, it is important to flag out that the MCES and the outcome of the econometric trials are indicative for repercussions of food price fluctuations (as measured by the MCES) on household food and nutrition security. Secondary data that combine price market information, household characteristics and individual dietary intake and health information for all members of the household were virtually un-existent when this analysis was undertaken. While it is common practice, especially among economists, to adopt household level surveys for nutritional analyses, this thesis recognizes the limitation of such approach. Anthropometric indicators are influenced by a wide range of factors that are methodologically cumbersome to isolate. In addition, household level information may obscure gender and age related discriminations and are un-responsive to intra-household processes that determine individual food and nutrition security status.

In closing, the hypothesis tested in the MCES validation procedure, using the case study for Bangladesh suggest that the MCES is negatively associated with food and nutrition security, measured through via FCS, SAFI indicators and child and maternal anthropometry. The empirical analysis that employs two sets of methods (Pearson correlation coefficients analysis and regression models) support the theory (developed in Chapter 3), and in particular, it suggests that the MCES is elastic to variations of short-term food and nutrition security indicators (dietary diversity, meals numbers eaten, and maternal wasting). In particular, the use of adult anthropometry provides additional information on how food prices may affect short-term nutritional status of adults that could cut-off on their own food intake to maintain that of young children unchanged. The direction and severity of the MCES association with the selected comparator measures varies over expenditure groups and in particular, the marginal effect graphs suggests that poorer households might be more severely affected especially as regards to short-term indicators of food and nutrition security.

The following section, provides additional evidence of robustness of the MCES methodology.

6.5 Robustness check

Robustness checksforthe MCES validation estimates compare the use of the MCES to individual staple food prices, and assess whether equally good or better results, in statistical terms, are produced. Three approaches are selected to evaluate the efficiency and validity of the statistical results from the models (described in Chapter 3). First, Akaike Information Criteria (AIC) and Bayesian Information Criteria (BIC),followed by a set of F-tests for nested models and concludes by discussing a sensitivity and specificity analysis. The section discusses the results of each robustness check approach individually.

Akaike Information Criteria and the Bayesian Information Criteria

As noted in section 5.3.1, the MCES in the Bangladeshi case study only includes rice prices (average price by upazila, expressed in Taka per Kg). Therefore, the alternative measure to the MCES, tested in the robustness check, is represented by rice prices only. The AIC and BIC is estimated for six food and nutrition security comparator measures: Food Consumption Scores, adult and children food consumption (the day prior the interview) and child and maternal anthropometric measure.

As indicated in Table 6.12, the coefficients associated with the MCES are negative and significant (with the exception of child wasting) while estimates associated to rice prices for each of the model exhibit mixed results: they are negative for FCS and meals numbers eaten by adults (negative association and for the latter statistically significant (p-value<0.01)), but the estimated coefficients turn positive for the remaining measures. This can indicate unsound association between rice prices and food and nutrition security indicators.

In terms of the AIC and BIC interpretation, the models incorporating the MCES show smaller values and therefore are considered to better approximate the data while minimizing the loss of information. The AIC and BIC values are only marginally smaller for the MCES compared to the models that include rice prices for almost all food and nutrition security indicators, with the exception of meals consumed by adults, where the MCES model appears to substantially improve the estimation.

Table 6.12 AIC-BIC: alternative regression coefficient estimates for robustness check (Bangladesh)

	FCS	# of meals (adults)	# of meals (children)	Child Wasting (by whz)	Child Stunting (by haz)	Maternal Wasting (by MUAC)
	OLS	Odered Logisitc		OLS		
MCES	-27.165***	-1.536***	-1.343***	0.112**	-0.392***	-3.865***
AIC	86872.5	6472.0	13902.7	23267.8	27842.7	63470.3
BIC	87023.9	6659.5	14068.3	23433.3	28029.5	63654.3
Rice Price	-0.0154	-1.342856***	0.0259**	0.090***	0.130***	0.3282*
AIC	87213.9	13902.7	13910.7	23136.77	27723.01	63505.69
BIC	87365.3	14068.3	14076.3	23302.34	27909.78	63689.72

Source: Author, from BHFSNA (2009) data.

F-test for nested models comparison

Using the F-test for nested models, the aim is to assess whether the model (that comprises the MCES) contributes additional information about the association between each dependent variable (food and nutrition security comparator measures) and the individual staple prices (in this case only rice). The F-test compares the sum of squares residuals (SSR) of the restricted model - without the MCES - (SSR1) and the full model – with the MCES (SSR2). If the F-test is significant, the full model statistically improves the predictive power of the model. Seven sets of models are tested for each of the food and nutrition security comparator measures employed in the micro-validation.

The results, illustrated in Table 6.13 to Table 6.15, indicate that the full model (the one incorporating the MCES) statistically improves the estimation of the equation relative to the Food Consumption Score, adult meals number, food sufficiency and maternal wasting (by MUAC). The mentioned indicators are associated with short-term manifestation of food and nutrition security deterioration and the outcome of the F-test for nested models confirms the pattern that have been observed through the validation process. Therefore it suggests that the MCES proves to be more sensitive to short term variations of food and nutrition security.

Table 6.13 F-test for nested models comparison, 1 (Bangladesh)

	Restricted	Full		RestrictedModel	FullModel
VARIABLES	FC_SCORE	FC_SCORE		meals_num_adults	meals_num_adults
MCES		-9.131***			-0.113***
		(0.548)			(0.00950)
Rice Prices	0.245**	0.341***		0.00195	0.00314*
	(0.105)	(0.104)		(0.00182)	(0.00181)
HHExpenditure	0.000948***	0.000840***		5.64e-06***	4.31e-06***
	(2.01e-05)	(2.08e-05)		(3.46e-07)	(3.61e-07)
Constant	44.18***	45.21***		2.864***	2.877***
	(2.741)	(2.706)		(0.0472)	(0.0469)
Observations	10,335	10,335		10,335	10,335
R-squared	0.179	0.201		0.026	0.039
df_m	2	3		2	3
F	1130	865.9		135.2	138.3
rss	3.78E+06	3.68E+06		1122.45312	1107.3574
F-test		277.8			140.8
Prob > F		0.0000			0.0000
Standard errors in parentheses					
*** p<0.01, ** p<0.05, * p<0.1					

Source: Author, from BHFSNA (2009) data.

Table 6.14 F-test for nested models comparison, 2 (Bangladesh)

	RestrictedModel	FullModel		RestrictedModel	FullModel
VARIABLES	meals_num_children	meals_num_children		food_suff	food_suff
MCES		-0.0808			0.118***
		(0.0843)			(0.0139)
Rice Prices	-0.0724***	-0.0713***		0.00919***	0.00794***
	(0.0111)	(0.0112)		(0.00265)	(0.00264)
HHExpenditure	1.22e-05***	1.12e-05***		-1.34e-05***	-1.20e-05***
	(2.23e-06)	(2.47e-06)		(5.04e-07)	(5.28e-07)
Constant	5.895***	5.899***		0.438***	0.425***
	(0.290)	(0.290)		(0.0688)	(0.0686)
Observations	4,369	4,369		10,335	10,335
R-squared	0.015	0.015		0.065	0.071
df_m	2	3		2	3
F	33.63	22.73		356.5	263.4
rss	7665	7664		2383	2366
F-test		0.919			72.37
Prob > F		0.338			0.0000
Standard errors in parentheses					
*** p<0.01, ** p<0.05, * p<0.1					

Source: Author, from BHFSNA (2009) data.

Table 6.15 F-test for nested models comparison, 3 (Bangladesh)

	(1)	(2)	(1)	(2)	(1)	(2)
	RestrictedModel	FullModel	RestrictedModel	FullModel	RestrictedModel	FullModel
VARIABLES	WHZ1	WHZ1	HAZ1	HAZ1	MUAC	MUAC
MCES		-0.164**		-0.368***		-0.334***
		(0.0796)		(0.0992)		(0.0769)
Rice Prices	-0.00187	0.000488	-0.0435***	-0.0381***	-0.0272***	-0.0224**
	(0.0106)	(0.0107)	(0.0133)	(0.0133)	(0.0103)	(0.0103)
HHExpenditure	1.01e-05***	7.99e-06***	2.18e-05***	1.71e-05***	1.98e-05***	1.55e-05***
	(2.16e-06)	(2.40e-06)	(2.70e-06)	(2.98e-06)	(2.09e-06)	(2.32e-06)
Constant	-0.772***	-0.763***	-0.929***	-0.909***	-1.036***	-1.018***
	(0.278)	(0.278)	(0.346)	(0.346)	(0.269)	(0.268)
Observations	3,959	3,959	3,959	3,959	3,959	3,959
R-squared	0.005	0.007	0.018	0.022	0.023	0.028
df_m	2	3	2	3	2	3
F	10.93	8.696	36.50	29.00	46.77	37.60
rss	5937	5930	9228	9196	5564	5538
F-test		4.218		13.75		18.84
Prob > F		0.0401		0.000211		0.0000
Standard errors in parentheses						
*** p<0.01, ** p<0.05, * p<0.1						

Source: Author, from BHFSNA (2009) data.

Sensitivity and Specificity analysis

The classification table is a method to evaluate the predictive accuracy of the logistic regression model. In this tables the observed values for the dependent outcome and the predicted values are cross-classified. Similarly to Chapter 6, the dependent variables are transformed in dichotomous variables (Sultana et al. 2015,Mogeni et al. 2011). Secondly, the naïve estimate (at the bottom of Table 6.16 and Source: Author, from BHFSNA (2009) data.

Table 6.17) is defined as the probability of being food insecure (value of the comparator measures equal to 1), without the introduction of the MCES in the model. Thirdly, five logistic regression models are estimated (between each comparator measure) where the MCES is introduced as a covariate. Then, the classification table is estimated. Finally, the values of the naïve hypothesis are compared and analysed against the correctly classified ones as an indication that the inclusion of the MCES in the model improves (or does not improve) the capacity of the regressions to identify food secure and food insecure households and individuals.

The table below reports the results. Overall, the introduction of the MCES improves the predictive capacity of the model, especially to what concerns the models pertinent to food sufficiency, child stunting (by HAZ) and maternal wasting (by MUAC). In the case of the FCS, adults meals number and child wasting (by WHZ) the inclusion of the MCES improves the sensitivity classification of the models.

Table 6.16 Sensitivity and Specificity Analysis – correct classification rate for logistic model 1 (Bangladesh)

			Food Consumption Scores	meals_num_adults	meals_num_children
			1 if FCS>=42* 0 if FCS<42	1 if meals#>2 0 if meals#<=2	1 if meals#>4 0 if meals#<=4
Sensitivity		Pr(+ D)	85.54%	89.89%	2.91%
Specificity		Pr(-~D)	3.09%	3%	84.92%
Positive predictive value		Pr(D +)	53.71%	80.50%	53.46%
Negative predictive value		Pr(~D -)	54.77%	11.43%	51.44%
False + rate for true ~D		Pr(+~D)	76.91%	89.71%	0.40%
False - rate for true D		Pr(- D)	4.46%	0.01%	77.09%
False + rate for classified	+	Pr(~D +)	26.29%	0.90%	26.54%
False - rate for classified	-	Pr(D -)	25.23%	68.57%	28.56%
Correctly classified			53.79%	80.41%	30.62%
Naïve Hypothesis			51.49%	80.48%	51.60%

*Food consumption Score cut-off point corresponds to the value indicating borderline consumption score (BHFSNA 2009). There is a lack of agreement on the adequate cut-off point of meals frequency, both for adults and children. This exercise adopts a stringent definition of optimal meals number, meaning that the cut-off is set at the median meals number value added by one.

Source: Author, from BHFSNA (2009) data.

Table 6.17 Sensitivity and Specificity Analysis – correct classification rate for logistic model 2 (Bangladesh)

			Food_suff	WHZ	HAZ	MUAC
			1 if HH is Food sufficient	1 <=-2	1<=-2	1<=221*
			0 if HH is Food insuffcient	0 >-2	0 >-2	0>221
Sensitivity		Pr(+ D)	76.53%	0.00%	20.72%	1.89%
Specificity		Pr(-~D)	47.13%	100.00%	83.85%	98.57%
Positive predictive value		Pr(D +)	64.77%	.%	53.99%	43.28%
Negative predictive value		Pr(~D -)	61.26%	86.09%	53.61%	63.43%
False + rate for true ~D		Pr(+~D)	52.87%	0.00%	16.15%	1.43%
False - rate for true D		Pr(- D)	23.47%	100.00%	79.28%	98.11%
False + rate for classified	+	Pr(~D +)	35.23%	.%	46.01%	56.72%
False - rate for classified	-	Pr(D -)	38.74%	13.91%	46.39%	36.57%
Correctly classified			63.58%	86.09%	53.68%	63.11%
Naïve Hypothesis			55.95%	13.91%	47.81%	36.71%

*MUAC cut-off point (in mm) based on WHO (1995b) definition of women global acute malnutrition by MUAC.
Source: Author, from BHFSNA (2009) data.

6.6 The MCES and validation results in the two case studies

The following section provides a comparative analysis from the validation of the MCES in the Mozambican and Bangladeshi case study. In addition to compiling the information on the estimated results across the case studies, the section reflects on the opportunities and challenges of working across two datasets.

As it emerged from the discussion in Section 5.4.2 on the Mozambican case study and illustrated in Table 5.16 (reproduced in the left panel of Table 6.18), the MCES appears to be sensitive to food and nutrition security indicators of short-term declines of access to food. The estimated coefficients produced with the different econometric assessments indicate that MCES is negatively and significantly associated with Household Dietary Diversity Score, number of meals consumed by adults and household food sufficiency. Similarly, the association with child anthropometrics is negative although with a less significant coefficients. These findings suggest that the MCES may offer an indication of variations in terms of food quality deterioration in face of food price increases and subsequent pressures on disposable income.

Table 6.18 Estimated coefficients form the MCES validation - A comparative overview

Mozambique

Estimator	Outcome indicator	MCES coefficient
	Diet Diversity Indicator	
Poisson	HDDS	-0.257***
		(0.0087)
	SAFI	
Ordered Logistic	N. of meals - adults	-0.910***
		(0.0536)
	Food insufficiency	-0.830***
		(0.0582)
	Child Anthropometry	
OLS	Child Wasting (by WHZ)	-0.178**
		(0.0813)
	Child Stunting (by HAZ)	-0.204**
		(0.0924)

Bangladesh

Estimator	Outcome indicator	MCES coefficient
	Diet Diversity Indicator	
OLS	FCS	-27.16***
		(7.314)
	SAFI	
Ordered Logistic[b]	N. of meals - adults	-1.536***
		(0.514)
	N. of meals - children	-1.343***
		(0.398)
	Child Anthropometry	
OLS	Child Wasting (by WHZ)	0.112*
		(0.0577)
	Child Stunting (by HAZ)	-0.392***
		(0.0777)
	Adult Anthropometry	
	Maternal Wasting (by MUAC)	-3.865***
		(1.479)

In the results of the second case study (that used household budget survey collected in Bangladesh) are reported in the second panel of Table 6.18. Similarly to the previous case study, the MCES appears to be mostly sensitive to food and nutrition indicators of quality and variety of diets (such as the Food Consumption Score) and meal frequency. The relationship between the MCES and anthropometrics however illustrates a mixed picture: while child stunting and maternal wasting are negatively and significantly associated with the MCES, the relationship between child wasting and the food price indicator is positive. Section 6.4.2 discusses various possible reasons for such outcome. One plausible explanation could be retraced in the delayed timing of data collection and therefore a partly missed opportunity to capture the effect of food price variations on indicators of child acute undernutrition. A different interpretation looks at the nature of the nutrition status indicators of children and their ability on identifying impacts of food price variations on child nutritional status. What is interesting for the purpose of this thesis, is to appreciate how the wider set of anthropometric indices, that includes adults biometric, together with qualitative information, can illustrate a granular picture on how households may adapt to sudden changes of food access in face of staples price increases and drops of disposable income. For example, while the association between the MCES and child wasting is positive, the association between the food price indicator and maternal wasting in negative, suggesting that there might be an adaptation of calories within the households in order to protect young household members from sudden food shortages.

Before moving on in the comparative analysis of marginal effects graphics for the two case studies, it is important to clarify a number of issues that emerged in the selection of the two case studies and the respective household budget surveys (a technical overview of such issues is presented in Chapter 4 – Section 4.3).

The MCES aims at offering a methodological alternative in analysing food prices in a way that is relevant to food and nutrition insecurity in LMICs. Therefore, during early stages of the thesis it was decided that the validation analysis would benefit from an assessment of the MCES performance across two contexts with different two agro-climatic conditions, food systems and food consumption patterns but with similar levels of severe food insecurity and undernutrition. Considerations over the selection of specific datasets are given fundamental importance in the thesis and the final choices are the result of a careful compromise in terms of the following criteria:

- Information needed to compute the MCES, and in particular market staples prices (as opposed to unit values[30])
- Information to calculate the wide range of food and nutrition security indicators and control variables (listed in Table 4.6)
- Incorporation of different contexts and ideally covering one country from Sub-Saharan Africa and a country in South East Asia.
- Selection of a survey period relevant to a food price crisis

After an accurate review using different research engines, survey databases and experts consultation, the Mozambican *Inquérito sobre Orçamento Familiar 2008-2009* (IOF08-09) and the *Bangladesh Household Food Security and Nutrition Assessment 2008-2009*(BHFSNA 2008-09) where selected. While IOF2008-09 fitted most of the criteria, the BHFSNA 2008-2009 only covered three months (starting from November 2008 to January 2009) defeating the possibility to assess seasonal analysis of the MCES in Bangladesh and perform the comparative analysis across the case studies. Both countries were severely affected by the 2008-2009 international food price crisis, as described in the introductory sections of Chapter 5 and 6.

Working across different datasets offers a wide range of opportunities as well as a fair amount of caveats. Among the benefits of conducting the MCES validation across two different contexts there is the fact that the usefulness of the indicator could be assessed and evaluated

[30]Conventionally, household budget surveys tend to gather unit values, a widely used proxy of commodity prices that is obtained by dividing household expenditure over the quantity bought of a given item. On the other side, nutritional and health assessments do not include information on market prices making the use of valuable data sources, such as the DHS, unfeasible.

across two different contexts while using different econometric methods. These associations, which are found in both contexts, do not depend on the method used to assess these associations, nor on dataset used in the validation assessment. However, the analysis of different datasets also means that a significant amount of time and resources are devoted to the understanding, cleaning and preparation of the data. This process emphasizes the importance of making comparisons and generalizations with special care due to methodological differences across different datasets. Surveys are designed with an attempt to answer to specific questions that are often adapted to the context they are deployed. In particular, the BHFSNA 2008-09 was designed for a rapid assessment to provide responses and recommendations to a food crisis that sparked in Bangladesh in 2008. The IOF 2008-09, however, is part of the National Institute of Statistics to inform and formulate the Mozambican government sectorial programmes. Surveys are collected over a full year and at regular intervals. This explains the different time-frames adopted in the two household budget surveys. Finally, the use of two datasets provided a first-hand opportunity to reflect and engage in the debate on the use of a mixture of data sources and indicators to perform nutritional assessment. As household budget surveys and household consumption and expenditure surveys are increasingly used to make inferences on individual nutritional status and food intake, there is an urge among researchers and practitioners to address some of the key methodological limitations, work towards harmonization of data collection practices, address challenges and avoid unhelpful duplications among nutritionists, economists and poverty analysts.

The section concludes by offering comparative overview of the marginal effect graphic for the two case studies. Marginal effect graphs visually represent the effect of interaction between the MCES and comparator food and nutrition security indicator over a selected dimension[31]. Due to the caveats presented in the section above, the exploration of patterns across the two case studies is presented considering the income distribution dimension only.

Examining the different impacts that food prices changes exercise on food and nutrition security of different income groups is incorporated in the construct of the MCES and is a recurrent theme in the description of the food and nutrition security indicators used in the validation. As poor and non-poor households are characterized by different food consumption

[31] Detailed explanation on the technical aspects on marginal effect analysis is presented in the dedicated sections in Chapter 5 and Chapter 6.

patterns and expenditure priorities, food price increases will have a different impact on each of them (Dorward 2013).

The graphs depicted in Figure 6.14 illustrate the predicted value of each dependent variable on the Y axis given the MCES value on the X axis, broken up over households expenditure groups (expressed in quintiles) for both case studies. The repetition of some of the graphs presented in the empirical chapters is made to facilitate the comparison. The negative (positive) slope of a curve indicates negative (positive) associations between the dependant variable and the MCES. The degree of the curve's concavity, indicates the strength with which changes in MCES are reflected in changes in the indicator used as the dependent variable.

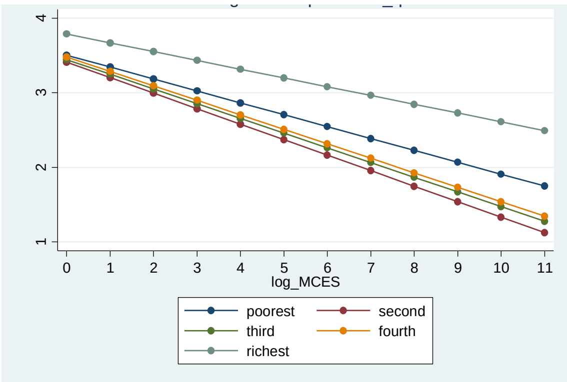
In the case of Bangladesh, the negative association between MCES and food consumption score appears to be more inelastic for the highest expenditure group followed by the lowest one. The negative associations for the expenditure groups in the middle of the income distribution on the other hand appear to be more prominent. The Mozambican case study reflects similar patterns: the consumption-calorie elasticity (how calorie acquisition responds to variations in income and prices) evolves - becoming more elastic- for middle income groups, while results more inelastic for poorer and richer ones. As discussed in Chapter 6, while the outcome of the association between the MCES and household dietary diversity indicators for the poor and wealthier households share similar patterns, the underlying causes could be different and different may be the ways that increases in food prices affect household food and dietary access. Such underlying causes were possible to explore thanks to the use of qualitative information and through the comparison with different indicators of food and nutrition security.

Underlying mechanisms that shape the association between the MCES and the comparator, and more generally the welfare variations of food price fluctuations can be related to the household position in terms of food production, consumption, and sale. In brief, a common feature of poor households in LMICs is that they are both consumer and sellers of their produces (Chapter 3, Section 3.1.1 offers a detailed discussion of the theory and implications). In the short-run, increases of food prices are likely to have a negative income effects on net-buyers of that food and a positive profit effect of net-sellers (that can translate increased income in the medium-long period). The MCES uses these concepts in its conceptualization by including income in the denominator in order to proxy the income effect of food price increases (see Chapter 3). However, the index calculated with the available data is unsuccessful to reproduce a dynamic evaluation of the impacts of food prices on household welfare. To do so longitudinal data that contain information on prices and expenditure measurement over time are needed. Panel data analysis would allow the evaluation of positive and negative impacts on different categories of households, distinguished along the line of food production, consumption and sale. This is particularly important when assessing the effects of price seasonality. Additionally, household livelihood strategies vary across seasons and can fluctuate between different degrees of net purchase and net sale of food.

Figure 6.14 MCES and Dietary Diversity indicators –Predictive margins across expenditure quintile in Mozambique and Bangladesh

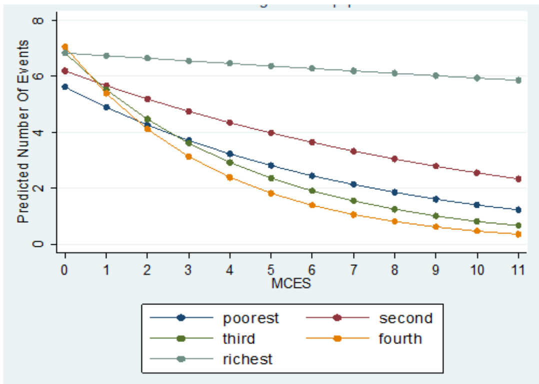
Bangladesh

Food Consumption Scores



Mozambique

Household Dietary Diversity Scores



Source: Author from BHSNA 2008-2009 and IOF 2008-2009 data

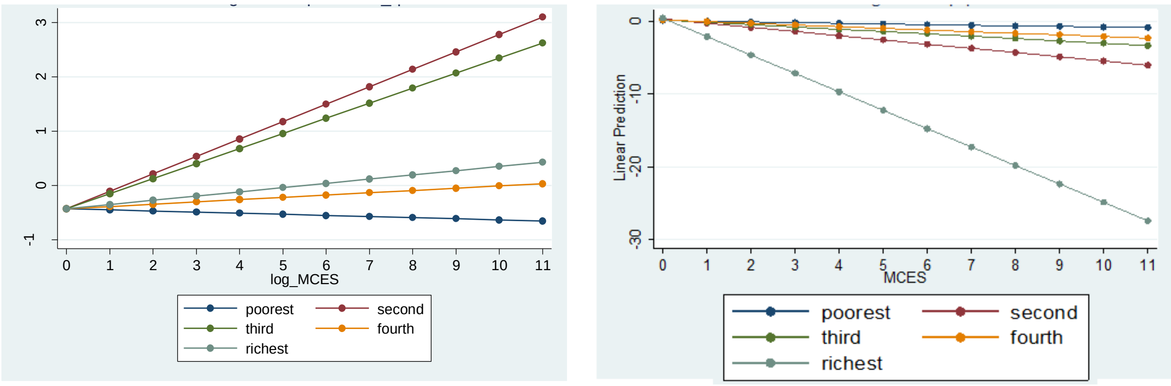
Another interesting insight on how households may adapt to food price fluctuations is offered by the association between the MCES and child wasting in the two case studies (as reported in Figure 6.15). Without entering in the merits of the trends of the association per se (which is analysed in Chapter 5 and 6), the pictures offered by the predictive marginal effect graphs show that there may be similar patterns of inelasticity around short term child access to calorie and staple foods between the two countries. As mentioned in the exposition of the Bangladeshi findings, the positive association between child wasting and MCES can reflect the protection mechanism of the younger members of the household in the short run. The positive association that presents larger magnitudes for middle-income groups followed by higher income ones is virtually inelastic for lower income households. Apparent similar predictive margins between poorer and richer households can hide, once more, radically different causes: one being too poor to modify food consumption behaviours (since they already consume the cheapest food options), while others being only marginally affected by variations of staple food prices.

Similarly, the overall negative association of the MCES with child wasting is dominated by the predictive curve associated to more affluent groups, while other households present similar and inelastic marginal predictive curves as the MCES increases. A large number of factors shape the direction and magnitude of predictive margin curves, but they hint to possible coping strategies directed to the protection of young children and the impossibility to alter household food allocation due to budget constraints. Unfortunately due to a lack of adult anthropometry indicators in the case study for Mozambique, it is not possible to verify potential effects that MCES might have of adult nutritional status.

Figure 6.15. MCES and indicators of child wasting– Predictive margins across expenditure quintiles in Mozambique and Bangladesh

Bangladesh **Mozambique**

Child Wasting (by WHZ) **Child Wasting (by WHZ)**



Source: Author from BHSNA 2008-2009 and IOF 2008-2009 data

In conclusion, the use of two datasets capturing different contexts and agricultural systems provided further depth in the assessment of the MCES validation. Overall, the regression analysis augmented by the granularity offered by the marginal effects assessment suggest that the MCES is associated to deteriorations of food and nutrition security indicators that reflect short term variations of food access and household adaptation to food and calorie intake stresses. The comparative analysis that considers the relationships between the MCES and comparative indicators across the two case studies, reveals different processes that shape the impact of food price variations on the different manifestations of food and nutrition insecurity. It also suggests, in agreement with other authors (Kiess et al. 2000) that the use of child wasting as indicator of acute undernutrition can cover household calorie and food adaptations that come at very high costs especially for medium and longer term health status. Nutritional analysis and data collection should widen the typology of household members that are conventionally monitored. As food insecurity is a “managed process” by all members of the household, intra-household strategies to respond to food crises (Coates et al. 2006)

As reiterated in different parts of the thesis, the MCES should be regarded and used as an early warning indicator that helps to expose negative impacts of food price variations on food and nutrition security in the short-run. Such rapid analysis can address researchers and practitioners towards critical avenues in terms of intra-household and individual repercussions of food price volatility and further examinations require adequate tools and context specific analysis.

6.7 Conclusions

The Bangladesh case study provides additional investigation to the validation assessment of the MCES. The chapter introduces the reader with the context by providing a country profile, briefly describing the agricultural sector and discussing the importance of food prices within recent history in Bangladesh. The Bangladesh Household Food Security and Nutrition Assessment (BHFSNA 2008-2009), a nationally representative household survey collected between November 2008 and January 2009 is used in the validation of the MCES. The MCES validation evaluates the association of the MCES with a set of food and nutrition security indicators. The hypothesis is that if the association is significant, the MCES can be considered a useful indicator to measure and monitor the effects of food price variations on food and nutrition security. The chapter concludes by comparing the results of the two empirical analysis. It presents similarities and differences from the two contexts as well as reflecting on the opportunities and challenges of working across two datasets.

Using a set of models for three classes of food and nutrition security this study finds that the MCES is highly elastic to indicators that detect short term manifestation of food and nutrition security. They include household dietary diversity scores (i.e. FCS), meals frequency (for adult and children), and maternal wasting (by MUAC). The negative estimated coefficients suggest that increases of the MCES can imply dietary diversity deterioration and reduction of meals number, indicators that are associated with short-term household food strategies, in face of hardships. Maternal wasting (that measures short-term nutritional impacts due to decreased food intake) appears to be negatively associated with the MCES, adding further support to the validity of the MCES. The marginal effect analysis allows the investigation of the impact of MCES increases on the comparator measures across different expenditure groups. The figures suggest that poorer expenditure groups can be more severely affected by increases of the MCES, emphasizing the relevance in providing disaggregated picture of food price’s impacts on welfare and food and nutrition security.

The MCES validation offered a number of lessons and characterized by a number of limitations. Determining most appropriate empirical strategy and data preparation took the most time. This emphasized the absence of ready-to-sue methods and approaches, and the final choice of the analytical approaches is the result of reiterative process. The nature of the data guided the process by opening avenues for exploring new themes, but is also imposed limitations and biases. Simultaneity, MNAR are those that have been detected and addressed.

The availability of maternal wasting (by MUAC) increases the understanding between food price variation and adult nutritional status. This work casts its results in the context of a broader debate on how assessments of short term impacts of food prices variations on food and nutrition security can be improved (Kiess et al. 2000). The validation of the MCES and robustness checks indicate that the MCES can provide useful indications of short-term effects of food price fluctuations on food and nutrition security of poor households in low income countries. It can complement established early warning tools (crop production assessment and rainfall monitoring) to timely intervene in case of food shocks. In can also serve at adequately evaluating and reporting seasonal variations of food prices and income and provide an inter-household picture on how different income groups may respond to and absorb food price shocks. However, for a thorough understanding of the mechanisms that shape food vulnerability with detrimental effects on nutrition and health, complementarity between quantitative and qualitative analysis is central. For example, dietary diversity measures, while being close proxies of dietary quality, may not indicate the how foods are distributed within the household and how this might change over seasons or across gender and age. Drawing from both empirical studies, the conclusion of the thesis addresses these issues in broader terms.

Chapter 7 Conclusions

By revisiting the aim of the thesis, this concluding chapter first reviews the rationale and approaches of the research (7.1) and then presents the key findings as they relate to the research questions (7.2). By taking a step back, the chapter is an opportunity to look at the broader implications of the findings, the limitations of this work (7.3) and areas for future research (8.4).

7.1 Objectives, research questions and methodology

International organizations and governments showed a renewed interest in food security and undernutrition as the result of the food crises in 2007-2008. High food prices and social outbreaks in a large number of countries, awakened concerns that food supplies could not meet the needs of a growing global population. In 2008 the food crisis had all the attention of the world's media, but by the and the international arena reacted by launching different initiatives and programmes. However, with the spread of the financial crisis in rich economies and steady decrease of international food prices, attention drifted elsewhere. Indeed, international commodity prices started a gradual decline from 2011, but trends and levels of domestic food prices are often very different from international ones with many low-income countries still experiencing prices as high as the ones observed at the peak of the 2008 crisis (Hauenstein Swan et al. 2010).

As the political interest shifted to other themes, the call to address methodological limitations on how food and nutrition security is measured remains generally un-answered (Dowrard 2013, Headey and Ecker 2012). One persistent methodological shortfall remains with the way real terms prices are calculated (addressed in Chapter 2). The conventional approach to adjusting for inflation poses several problems when assessing the impact of food prices on the welfare, food and nutrition security of the poor in low-income countries. The use of the US CPI (or other global price indexes) tends to artificially dampen the magnitude of observed price increases, since their construct follows consumption patterns of higher income groups and countries (Dorward 2011).

This thesis contributes to the methodological gap by developing and assessing the validity of the Minimum Calorie Expenditure Share (MCES), a novel food price indicator that calculates the expenditure required to meet a minimum per capita calorie requirement from staples consumption as a share of total expenditure. The MCES incorporates prices of context specific staple foods and instead of using international deflators specific to rich economies, it uses household expenditure to approximate (staple) food affordability. The developed price indicator is centred on factors relevant to a low-income context and aims at providing a robust platform for assessing how changes in food prices affect the food and nutrition security of poor population. When measuring the impact of food price fluctuations on food and nutrition security, key questions concern the extent to which food insecure populations is affected by food price increases and how far the effects of food price rises are counteracted by economic and income growth. This thesis argues that the relationship between food prices and variations of disposable income is critical for interpreting food and nutrition security of vulnerable population in low-income countries and the said relationship should be central to the assessment of food and nutrition consequences of food price shocks.

The methodology introduced by the MCES allows the consideration of three factors that shape food and nutrition security in low-income countries: domestic food price fluctuations, disposable income and seasonality related vulnerabilities. The development of the MCES incorporates context specific staple food prices that are weighted to represent their consumption. Alongside, the indicator includes the household expenditure that accounts for the income effect of food price changes. It meets the criteria of simplicity, cost-effectiveness and it is quick to collect and compute. In particular the MCES can prove to be a valuable tool to monitor, assess and report short term impacts of food price changes on food and nutrition security of poor populations in low-income countries. It offers a window to explore the inter-household effect of food price fluctuations both as regards to “exceptional” food price shocks as well as seasonal price variations. The MCES can be calculated with currently available data and can be used to inform interventions in a timely manner to buffer the deepening of nutritional and health related consequences of food prices shocks.

The first part of Chapter 2 sets the ground for methodological improvements, suggesting that there is room to develop alternative food price indicators appropriate to measure the impacts of food price fluctuations on food and nutrition security of vulnerable segments of the population in low-income countries. The methodological approach is based on microeconomics theories on consumer behaviour and on the existing literature on nutrition that analyse pathways between food price fluctuations and food and nutrition security.

The main research objectives concern methodological aspects of how impacts of food price changes on food and nutrition security of poor populations are measured and interpreted. In particular, this work is interested in investigating whether considering the interaction between (food) prices and income provides an improved representation and measurement approach to the conventional approaches. Following on from this, the work attempts to offer a valid alternative to the use of real term food prices while taking into account considerations on the timeliness and cost-effectiveness of the MCES. The research questions and sub-questions aim at looking at the following isues:

1. Is the methodological approach developed by the MCES able to overcome some of the shortcomings of using food prices in real terms for measuring the impacts of food price fluctuations on food and nutrition security of poor population in low-income countries?

    a) What are the repercussions of food price fluctuations on food and nutrition that the MCES captures in a more accurate way?
    b) Does the property of disaggregating the MCES by income groups provide a better understanding of the mechanisms through which food price fluctuations impact food security and nutrition status of different segments of the population?
    c) Can the MCES contribute to evaluating the role of seasonality on food and nutrition security?

2. Bearing in mind the need to measure and respond to food price shocks in a timely and effective manner, is the MCES a viable alternative to individual real food prices for monitoring the effects of changing food prices on food and nutrition security?

The first research question is broken down into three sub-questions that emerged from incorporating aspects of food price fluctuations going beyond the international food price crisis framework and look at the cyclical dimensions of hunger seasons and their repercussion on nutrition. The second question addresses the call for pragmatic and cost-effective methodological development to monitor and report food and nutrition security in a timely manner.

These research questions and sub-questions are addressed using an interdisciplinary approach, grounded in micro-economics and nutrition. Chapter 4 develops the empirical strategy to address the research questions in terms of the validation of the MCES, which is defined as the assessment of the association between the MCES and a set of widely used food and nutrition security indicators[1] at the household level. The aim of the validation is to compare the MCES against commonly used and validated food and nutrition security indicators. The core assumption of the MCES validation exercise is that *if the MCES proves to be consistent with commonly used and validated food and nutrition security indicators, it can be considered, in turn, a useful monitoring tool on the effects of food price fluctuations on food and nutrition security at the household level.*

Various estimation approaches are adopted: at first bivariate associations between the MCES and food and nutrition security indicators provide initial information on the direction of the association. This is followed by estimating a set of multivariate models. The hypothesis tested in the validation exercise (based on the theoretical framework described in Chapter 3) is that increases of the MCES (driven by food price increases and/or disposable income reductions) have detrimental effects on food and nutrition security indicators. Therefore, it is expected that the correlation coefficients and the estimated coefficient (β_1 in Equations 4.5, 4.10 to 4.14) will be negative. The two empirical chapters provide a coherent picture of the association between the MCES and the comparator measures. Regardless of the estimator and food and nutrition indicator used, the association is negative and significant (with the exception of child acute undernutrition in Bangladesh). Expenditure distribution and seasonality vary the ways in which the indicators interact, with poorer households generally appearing adversely affected by higher levels of MCES and the severity of the association exhibiting seasonal patterns.

7.2 Key findings

The MCES by taking into account food price increases in relation to household disposable income, can be interpreted as a measure that proxies purchasing power of staple food price increases, especially in the short-run when adjustments of disposable income and consumption patterns have not yet taken place. This is particularly relevant to those that devote a large share of their expenditure to cheap and high-energy foods; for this category, staple food price increases of can significantly damage access to adequate quality and quantity of micro and macronutrients. Declines in access to food is one of the causes of food insecurity

[1] These indicators include, household dietary diversity scores (HDDS): food consumption score (FCS): self-assessed food insecurity indicators, and finally child and maternal anthropometric measures.

and can have concerning nutritional consequences in the short-run especially for children, pregnant and lactating women and other vulnerable adults. Adverse food security and nutritional consequences can be more severe for households with lower income levels and for those that are vulnerable to seasonal fluctuations of food prices and income generation opportunities. The validation of the MCES explores these issues using a lens that takes into consideration patterns along income distribution and seasonality pressures.

The following sections present the key findings in relation to each research question they address.

1a) What are the repercussions of food price shocks on food and nutrition security to which the MCES is more responsive to?

The construct of the MCES can prove to be a valuable method to gauge, monitor and report short-term food and nutrition security impacts of food price changes of more vulnerable strata of a population in low-income countries. The empirical analysis, conducted with data for Mozambique and Bangladesh over 2008-2009, suggests that the MCES is consistently associated with household food security indicators measuring food strategies that are adopted to rapidly address declines of household purchasing power, such as household dietary diversity scores, meals frequency and self-assessed food insecurity. Using the two case studies, the assessment of the MCES validation indicates that the estimated correlation and association between the MCES and indicators of household food security, that reflect short term food strategies adjustments, are negative and highly significant (p-value< 0.01).

The validation also shows negative association between the MCES and indicators that measure individual level repercussions of coping mechanisms in face of food price increases, such as child and maternal anthropometric measures. Estimated association between the MCES and child anthropometric measures, that are repository of biological, social, health and economic factors, offer mixed results across indicators and case studies. Despite child and maternal weight-for-height z-scores (an indicator of acute undernutrition) being negatively and significantly associated with the MCES, the association is not consistent across the empirical analysis. While the correlation between the MCES and child acute undernutrition (by WHZ) is negative and highly significant (p-value< 0.01) for Mozambique, it is positive for Bangladesh. However, maternal acute undernutrition by MUAC is negatively and significantly (p-value<

0.01) associated with the MCES for Bangladesh, but there are no comparable data on adult nutritional status to perform the same analysis for Mozambique.

These results raise a number of questions on the linkages between food prices and nutrition: what is the purpose of child anthropometric measures with respect to food price increases? What is their relevance in the context of food price variations? In the context of the prevention of food crisis impacts, anthropometric measures may be indicating nutritional deterioration when intervention is too late. Analogously, when food prices are analysed in a context of seasonal fluctuations, anthropometric measures (especially for infants and children) might not be adequate to evaluate detrimental effects on nutrition security. Food insecurity is a "managed process" (Coates et al. 2006) and unchanged child WHZ scores can hide coping strategies that damage the nutrition and health of other household members as well as hindering the capacity to cope with future shocks. Indeed, while in the Bangladesh case study child wasting measures appear to be positively associated with increases of the MCES, maternal MUAC (indicator of adult wasting) is negatively and significantly affected (p-value< 0.01) by the same increases of the food price indicator. This outcome suggests that in the short run, adult members (in this case mothers) could put in place mechanisms to protect the nutritional status of young children to the detriment of their food intake and nutritional status. Unfortunately due to a lack of adult anthropometry indicators in the case study for Mozambique, it is not possible to verify potential effects that MCES might have of adult nutritional status, and more generally, without the anthropometric measures on all household members, little is revealed about the processes and mechanisms that households may put in place in the short-run to manage declines in food intakes.

In conclusion, the association between the MCES and the different comparator measures does not operate in a uniform way across the two case studies. Similarities can be found between the outcomes of the two empirical analyses and overall household food security indicators appear to be more elastic to variations of the MCES. The strength of association between the MCES and measures of household food insecurity self-assessment, dietary diversity and number of meals (that are connected to short run food strategies and repercussions of sudden increases of food prices) exhibit negative and highly significant association with the MCES. The association weakens for indicators of child acute and chronic undernutrition. Unsurprisingly, the dynamic through which food price variations (detected by the MCES) affect different dimensions of household and individual level food and nutrition security differs between Mozambique and Bangladesh.

1b) Does the property of disaggregating the MCES by income groups provide a better understanding of the mechanisms through which food price fluctuations impact food security and nutrition status of different segments of the population?

Producing a disaggregated assessment of the association of the MCES and food and nutrition security across expenditure group allows a more detailed account on how food price impacts may vary across these different groups. The MCES incorporates the income effect, since fluctuations of staple food prices are counter balanced by household's disposable income. The MCES is expected to be higher for lower income populations, as food expenditure represents a significant share of their total expenditure, and gradually decreases as expenditure rises. In both the Mozambique and Bangladesh case studies, values of the MCES for the first income quintiles are significantly higher than other expenditure groups, in line with the straightforward intuition about food affordability of poorer households.

The following section reviews the strength of the association between the MCES and food and nutrition security comparator measures across household expenditure distribution and reflects on the empirical evidences examined in the validation exercise. Before moving to the discussion however, it is important to reinstate the relevance of looking at the disaggregated impact of food prices on food security across income groups. This approach offers a window to understand how differences in food consumption patterns and expenditure priorities of different households' groups shape the impacts of food price fluctuations on food and nutrition security.

When considering the association between the MCES and indicators of household dietary diversity (i.e. HDDS), the Mozambique case study exhibits negative and significant values for poorer income groups and gradually easing for richer households. Among households in Bangladesh, the negative association between the MCES and the Food Consumption Scores is weaker for poorer households, suggesting that they may experience relative inelasticity to changes of staple food prices (i.e. rice). Conversely, MCES fluctuations are more sensitive to food and nutrition security indicators of better-off households, suggesting that poorer household's inelasticity of household dietary diversity index to MCES's variations may be driven by the impossibility to change calories consumption patterns as the household is already purchasing the cheapest calorie source available on the market. In Bangladesh, rice represents the main calorie source and there virtually no other substitutes. In Mozambique however, cheap calories can be derived from maize, cassava and, to some extent, rice allowing some degree of substitution among these calorie dense foods.

In brief, disaggregating the effects of food price changes in terms of income distribution presents the advantage of introducing an iter-household evaluation of the complex dynamics between food price changes and impacts on food consumption in the short-term. Disaggregating along the lines of income distribution represents a first step to understand some of complex dynamics between food price variations, food consumption and nutritional outcomes. This approach moves beyond the use of national level price data that often mask micro-level impacts. However, the relationship between food prices and disposable income represents one of the pathways and a short-term temporal framework that shape food choices, food purchase with consequences on nutritional status and health. Such analyses are a first door that allows refining the direction of examination and identifying the adequate tools and approaches to undertake further analysis.

1c) Does the MCES offer additional information on seasonality and the tension between income generation and food prices?

The conceptualization of the MCES incorporates seasonal aspects of food and nutrition insecurity from the outset. Seasonality plays a crucial role in determining nutritional outcomes among the vulnerable population, but it has been often ignored in the design of policies and interventions (Devereux and Longhurst 2010). However, in countries where agriculture is predominantly rainfed, food price fluctuations are cyclical their deteriorating effects on food and nutrition security operates in combination with limited income generation opportunities, lower wages and adverse weather conditions.

The empirical analysis conducted with the Mozambique data includes the assessment of the association between MCES and food and nutrition security indicators over survey quarters, allowing the evaluation of the seasonal patterns between MCES values, dietary diversity score, SAFI measures and child wasting (by WHZ). The depth of the negative associations with higher MCES levels appears to be consistently more severe during the second and third quarter of the IOF2008-2009 survey. These months correspond with the second half of the lean season and beginning of harvest that, in turn, coincides with the rainy season and higher food prices. The picture offered by the MCES includes both the depth of the repercussions of food price shocks on food and nutrition security for the poorest, but also its significant seasonal variability. MCES's seasonal trends for the first income quintile for example, illustrates that, compared to other expenditure groups, higher values are observed together with higher levels of seasonal variability.

Due to lack of seasonal data, this work does not assess empirically the seasonal implication of the association between the MCES and food and nutrition security indicators. The thesis acknowledges this limitation but recognises the importance of monitoring seasonal pressures on food and nutrition security in Bangladesh.

This analysis offers a dynamic approach to measure the impact of food price fluctuations on food and nutrition security. Different elements that shape food vulnerability are combined: food price changes, disposable income, and seasonal aspect of food production and income generation opportunities. The key issue is represented by the fact that these threats to livelihoods intertwine in different ways and stages of the agricultural cycles, shaping the deterioration of food consumption and nutrition. In turn, this is reflected on the impacts of food price increases on food and nutriotion security during different phases of the agricultural cycle. The analysis reveals different levels of interconnections between food prices, income and seasonality. Values of the MCES reflect both variations in food prices as well as changes in disposable income. Both are highly seasonal, especially in rural areas with tensions between high food prices and low labour demand during the rainy season (Devereux and Longhurst 2010). The MCES allows the measurement and analysis of the impact of food price changes on food and nutrition security that is representative of seasonal aspects that produce household food vulnerabilities. International food price shocks represent a serious challenge for food insecure population. However, volatile food prices and hunger have long been a feature of developing economies and the seasonal analysis of the tensions between food prices and income generation provide a platform to address structural challenges of food production systems, labour and income generation opportunities.

1) Is the methodological approach developed by the MCES able to overcome some of the shortcomings of using food prices in real terms in measuring the impacts of food price fluctuations on food and nutrition security of poor population in low-income countries?

The discussion of the three preceding sub-questions help articulate the answer to this over-arching research question and to discuss the statistical implications of the methodological approach of the MCES. As described in Chapter 1, the criticisms of the construct of real food prices and their deflators (i.e. US CPI) reside in the fact that they are based on measures centred on economies and societies that have experienced sustained income growth. This methodological factor implied that the dominant discourse on food prices was characterized by contradicting positions and emphasized the need for better measurements of food price changes. In particular this thesis aims at developing a measurement of food price changes on food and nutrition security with parameters that are relevant to the context where food insecurity occurs the most. Prices need to be calculated in ways that are relevant to the context and individuals who are mostly affected by them: poor populations who have not enjoyed income growth and for whom the US CPI is not an appropriate deflator.

The MCES is an intuitively appealing metric for describing the short-term impact of volatile food prices on the food and nutrition security of different income groups. It is set on a sound theoretical base as regards to the understanding of economy-wide processes of poor agrarian contexts and consumer behaviour (Chapter 3). The core of the methodological improvement resides in the dynamic relationship between food prices and disposable income serving as a proxy for food affordability. Firstly, it allows to differentiate between impacts on people with different incomes. Low-income food buyers assign high priority to food expenditure, spending a large portion of their income on food. For them, food price increases, especially in the short–term, can lead to larger reduction in disposable income with consequent effects on nutrition, health and non-food expenditure (such as investment in schooling and income generation activities). Better off food buyers, who devote a smaller proportion of their income to food, do not have to prioritise food in the same way. The possibility to discern the ways in which food prices may impact different income groups, enriches the understanding of the problem. Secondly, the MCES is able to translate the tensions between food prices and income into a seasonal perspective, introducing an often neglected dimension of food and nutrition insecurity that represents chronic challenges of the global food systems.

The MCES statistical properties are assessed through three robustness checks. The results suggest that the MCES is generally statistically robust and provides methodological improvements in relation to the use of individual food price data in the context of monitoring and assessing food and nutrition security deterioration as a result of food price fluctuations.

The robustness checks confirm that the MCES statistically contributes to the models and estimation of the impacts of food price fluctuations on food and nutrition security, without adding further layers of complexity.

2) Bearing in mind the need to measure and respond to food price shocks in a timely and effective manner, is the MCES a viable alternative to individual real food prices for monitoring the effects of changing food prices on food and nutrition security?

The MCES is a pragmatic effort to contribute to the methodological improvements needed in assessing, monitoring and reporting the effects of food price fluctuations on food and nutrition security. The conceptualization of the MCES is guided by a set of criteria that include:

- Reproducibility: the results can be replicated by anyone at any time, since all the necessary resources and methodology are transparently and accurately provided and explained.
- Simplicity: the information should be accessible to a wide range of audiences (domestic policy-makers, media and civil society).
- Achievability and cost-effectiveness: the indicator should use attainable methods and underlying data that can be realistically gathered within reasonable costs.
- Timeliness and intertemporality: data and methods are easily retraceable and the methodology allows for timely responses. In the context of food security and agriculture, the inter-temporal criterion emphasizes temporal comparisons on two levels. Firstly, the ability to measure the effects of seasonality on food and nutrition security. Secondly, the capacity to consider the outcomes of significant short run shocks.

In this sense, the MCES represents a reproducible and simple indicator that uses available data sources (staple food prices and consumption expenditure). It is characterized by an accessible methodology and can address short-run shock situations as well as seasonal fluctuations of both food prices and income. Domestic food price data are increasingly available and their collection is benefiting from innovation in the Information and Communication Technologies (ICT) sector, crowd sourcing and high-frequency data. Datasets such as the *FAO Food Price Monitoring and Analysis Tool* collect and display a vast amount of food data, which is accessible to use and present, within a time lag that usually does not exceed a month. The variety of food items is also increasing, incorporating commodities that are not relevant on international markets but are fundamental in diets in different contexts. These promising avenues can offer effective solutions for improving the measurement and information on food availability and affordability without exercising further pressures on statistical offices in low-income countries.

In closing, this thesis has sought to contribute to the literature on real prices, inconsistency in interpreting food crises and lack of timely indicators. It has done so by developing a pragmatic and novel methodological approach in measuring the effects of food price changes on food and nutrition security. It demonstrates that the contradiction within the debates on food prices can arise from the use of real price deflators that are not centred on factors specific to the population that experiences food insecurity. This work highlights that analysing the impacts of food prices as a dichotomy between international food crises and localised price fluctuations misses key dynamics in the creation of food vulnerabilities.

7.3 Limitations of the thesis

Limitations specific to each of the empirical chapters have already been individually raised. This section summarizes the overarching themes and distinguishes two levels in the discussion: limitations in the construct of the MCES and limitations of the approaches adopted in its validation.

An element that has been closely evaluated from the outset of the thesis, is represented by the inclusion of subsistence consumption in the food intake of small scale farmers. Data and methods in transforming subsistence consumption into monetary values and ways to incorporate this information in the MCES resulted cumbersome and only feasible with microlevel data, and therefore difficult to reproduce to higher aggregation levels. In general, this tended to violate the simplicity criteria as well as clashing with data accuracy on subsistence consumption. It is therefore important to reiterate that the MCES represents the cost of a minimum amount of calories from staple foods as a share of the household consumption expenditure. It can provide a provisional and initial indication of the deterioration of food affordability. The empirical analysis attempts to statistically control for subsistence consumption correcting for a set of variable, such as land ownership, sale of agricultural products and home garden cultivation, and produces robust estimates on the association between the MCES and comparator measures of food and nutrition security.

A second limitation linked to the MCES's construct relates to the intra-household *power* of the indicator. Because the MCES incorporates food prices and household expenditure, it can offer a first indication of inter-household differences in reacting and absorbing food price shocks, monitor purchasing power of different income groups and signal critical situations (cyclical as well as unexpected) in a timely manner. However, nutritional status is an issue pertinent to the individual and managed via mechanisms that operate within the household. Therefore household level analysis can overshadow intra-household mechanisms that shape food and nutrition security. The construct and the validation assessment of the MCES is informed by the methodological practices in economics and nutrition science and the availability of data sources. On the one hand, the calculation of the MCES requires market price data of food, information on household's composition and household expenditure and, on the other hand, the econometric models required for the validation assessment necessitate of comparator food and nutrition security indicators (at both household and individual level) and a wide range of comparator measure control variables. However, due to the scarcity of datasets that incorporate both levels of information (household and individual) and the absence of data on either market prices or monetary expenditure in nutritional assessments, the analysis had few options beyond using household level data offered by household budget surveys Therefore, the MCES is not a food price indicator that allows direct reading of intra-household effects of food price increases on food and nutrition security. Alternatively, it should be interpreted as a first entry point to identify adverse effects food price shock on food insecurity and nutrition that can help identifying intra-household food security repercussions of high food prices. As seen in Bangladesh validation exercise, the availability of anthropometric indicators for children under 5 and adults, allowed to start unveiling signals of protection mechanisms towards more vulnerable members of the household.

Limitations more specific to the validation analysis reflect the nature and the availability of datasets. In particular, to the author's knowledge, datasets that incorporate market food prices at disaggregated level, household consumption expenditure and different food and nutrition security comparator measures, are infrequent. Longitudinal and panel data are indeed more appropriate to assess over time impacts of food price variations on food and nutrition security, using Regression Discontinuity Designs (RDD) or Instrumental Variables (IV) to evaluate the impact of food price variations over time. Quantifying the full set of pathways that link food price variations to nutritional outcomes is an empirical challenge that is well-recognized. This is also epitomized by the limited economic literature in the domain. Especially in the long term, nutritional and health impacts of increased food prices get diluted with other factors. Concurrently, the literature of food price effects mainly rely on estimates produced with model simulations, which are based on stringent assumptions and have limited number of spatial observations of food prices. With this initial stage of the MCES validation, the thesis contributes in using micro-level data and highly disaggregated food prices.

7.4 Applications of the MCES and indication for future research

Stability of food access, availability and utilization is central to ensure food security. Seasonal climatic variations that can cause seasonal food restrictions affects both rural and urban poor. However, the seasonal characteristic of food production and consumption is often neglected in the design of agricultural interventions and omitted in food security policies. Mainstreaming seasonal outlooks in interventions is however crucial to provide adequate solutions to tackle the triad of seasonal hunger, lack of income generation opportunity and seasonal health-related adversities. The methodology of the MCES can prove to be a helpful starting point to re-introduce an important feature that affects rural livelihoods. It can allow a timely and cost-effective overview of seasonal patterns that characterize food prices in relation to income, offering a quick glance of the status of calories affordability with different aggregation levels – from national to household level. However, this exercise represents only a preliminary attempt to indicate a better alternative approached to look at the different manifestations of food price increases on food and nutrition security. This thesis may provide some grounds on which future research could build the grounds for different exploration of the interlinkages between food prices and food vulnerabilities.

For example, future research could expand on the different levels of food prices by using longitudinal surveys or panel data and adapting the lack of price data with alternative approaches. This work represents a grounding step in the MCES validation that considered nutritional validity a core criteria for the validity of the indicator. Assessing the nutrition validity implies the use of surveys that include the collection of disaggregated food prices in order to ensure high representativeness of the prices that are paid by the households. Further research that adopts a *relaxed* nutrition validity criteria on the selection of data sources can adopt prices deriving from other datasets, increasing the number of available datasets to perform further analysis with the MCES. In particular, the assessment of temporal changes of the impacts of the MCES on food and nutrition security, requires longitudinal data. This allows the additional evaluations on the impacts of food price changes over time and assessment of the impacts of both food price increases and decreases. Are decreasing prices detrimental for certain groups of households? What are the pathways between declining prices and food insecurity? Longitudinal datasets contain information on household consumption expenditure over a period of time supporting an analysis that looks at the evolution of food price changes in comparison to disposable income. This step represents a fundamental improvement in the possibility of the MCES to provide valuable information in terms of measurement of food affordability and impacts on food and nutrition.

The MCES can complement other early warning systems, such as remote sensing, crop production situation assessment and rainfall monitoring. After the 2007-2008 food price crisis large amount of resources have been invested to monitor prices of basic food items as well as initiatives to gather, process and deliver information on soil quality, crop productions and rainfalls. Several UN agencies have launched initiatives to explore the use of “big data” to accelerate the discovery of information and use the technologies for sustainable development and humanitarian action[2]. Price data can be gathered directly by consumers or via statistical models that look at price levels using social media (UN Global Pulse, 2014). These resources are valuable for developing future work for assessing the MCES methodology for looking at different food price cycles and expand the number of countries to perform further assessments of the food price indicator. A preliminary example of the potentials in using such data sources is presented in Annex I. After having calculated the MCES at the household level, Annex I illustrates the methodology and results of the MCES for higher aggregation levels for Mozambique and Bangladesh. Country average monthly food prices and national accounts for household consumption expenditure are used at this stage. This exercise provides an evaluation on the MCES methodological approach for a different scale of analysis. Despite limitations intrinsic to the data (especially regarding national accounts for household consumption expenditure) the MCES provides a more sophisticated picture on food price trends over time compared to individual food prices and food price indices. Disaggregating the MCES by expenditure groups, allows the assessment of the differential effect of food price rises on people with different incomes. The empirical analysis demonstrated that the MCES is

[2] See for example UN Secretary General initiative Global Pulse, G20 funded platform AMIS-Outlook that work alongside FAO and WFP to deliver quality and timely data using information and communication technology.

higher for lower expenditure groups and more volatile over time compared to MCES figures for higher expenditure groups.

With regards to intra-household impacts of food prices on food and nutrition security, more research is needed on the methods that are better equipped to collect data on these issues. As conventional data on nutritional status takes into account children and to some extent mothers, more thinking and resources on the research methods and techniques to study household and intra-household dynamics would be useful to expand the boundaries of this area of study. What are the impacts of food price changes on the nutritional outcome of adult members of the household? How do intra-household mechanisms protect or expose household members to adverse effects of increasing food prices? Addressing these questions will enrich the understanding of the differentiated impacts of shocks on food and nutrition security and contribute to the expansion of the analytical framework used to look at food-related vulnerability.

Finally, the domain of interdisciplinary approaches of food and nutrition analysis offers a wide and relatively unexplored area where methodological efforts are still needed. In particular, this research casts itself in the broader methodological debate that advocates methodological and standardization of data collection instruments. The increasing attention and increasing demand of food and nutrition security data has created a momentum for dialogue between nutritionists, economics and poverty analysts. For example, efforts have been directed in widening and adapting household budget surveys for food and nutrition security analysis. However, various areas of tension have been identifies. One is related to the rigidity of single disciplines in adapting own methodology, praxis and terminology. The other is related to the nature of the phenomenon under analysis and data availability. Food and nutrition security is a complex and elusive concept whose measurement has often been limited by data availability. While calling for more data collection is an appealing conclusion adopted by many, simple consideration on the fact that data do have a cost is often been overlooked (Jerven 2017). Costs linked with data include both financial constraints represented by their collection and maintenance as well as opportunity cost of competing with other priorities. This thesis engages with the broader debate on the importance of identifying pragmatic ways to improve measurement and the understanding of the underlying causes of food and nutrition (in)security. In particular, the MCES can offer a tangible tool to restate the importance of often overlooked factors, such as seasonality of food vulnerability, employing existing data sources.

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Appendix A Questionnaires

Mozambique

Reference Number

INSTITUTO NACIONAL DE ESTATÍSTICA

IOF 2008/9

CONFIDENTIAL

FAMILY BUDGET SURVEY - IOF 2008/9
DAILY EXPENSES

IDENTIFICATION
PROVINCE ____
DISTRICT ____
ADMINISTRATIVE POST
LOCALITY
NAME OF TOWN/NEIGHBORHOOD
COMMUNITY UNIT
URBAN / RURAL (URBAN = 1, RURAL = 2) ____
NAME OF CENSUS AREA
NUMBER OF CENSUS AREA IOF-ID
NUMBER OF FAMILY UNIT
NAME OF HEAD OF HOUSEHOLD

QUESTIONNAIRE

ON DAILY EXPENSES

OF THE

FAMILY HOUSEHOLD

CONFIDENTIALITY AND STATISTICAL AUTHORITY ----- LAW 7/96 (July 5)

ART. 6: STATISTICAL AUTHORITY - The principle of statistical authority consists of the power given to the National Statistics Institute, in the conduct of statistical activities, to do surveys with compulsory responses in the periods established, and to take necessary steps for the production of statistics.

ART. 14: STATISTICAL CONFIDENTIALITY -- All statistical information of an individual nature that is collected by the official statistics producing agencies in the framework of the National Statistics Institute, is highly confidential.

Reference number

DAILY EXPENSES OF THE FAMILY HOUSEHOLD

DAY: Nº

Date ____/____/____

If you bought a product today specify the type, the amount purchased, and the amount paid. Also indicate where you made the purchases.

	Product purchased	Unit of purchase	Quant.	Price (Mts)	Where bought Store..........1 Market........2 Infrml Mkt..3 Other........4	This amount is for how many days?	To be filled out by the interviewer Standard unit	Amount in standard unit	To be filled out by the coder Product code	Purchase unit code	Place code	Standard unit code
1	2	3	4	5	6	7	8	9	10	11	12	13
2	**Food products and nonalcoholic beverages**											
3	Rice (hulled)						kg		01.11.12			2
4	Corn meal						kg		01.11.41			2
5	Manioc meal						kg		01.11.46			2
6	Bread						Unit		01.11.61			2
7	Cleaned dead chicken						kg		01.12.61			2
8	Live chicken (live hen)						Un		01.12.79			2
9	Fresh fish, except *Carapau*						kg		01.13.11			3
10	*Carapau*						kg		01.13.21			2
11	Dried fish						kg		01.13.61			2
12	Cooking oil						L		01.15.41			2
13	Peanuts (shelled or unshelled)						kg		01.16.74			2
14	Coconut						Unit		01.16.76			2
15	Fresh tomato						kg		01.17.31			2
16	Butter beans						kg		01.17.51			2
17	Dried *nhemba* beans						kg		01.17.52			2
18	Fresh manioc						kg		01.17.82			2
19	Dried manioc						kg		01.17.83			2
20	Brown sugar						kg		01.18.12			2
21												
22												
23												
24												
25												
26												
27												
28	**Alcoholic beverages and tobacco** (except beverages bought in bars, cafés, tents, and taverns**)**											
29	Beer						L		02.13.00			3
30	Wine						L		02.12.11			
31	Cigarettes						Unit		02.20.10			1
32												
33												
34												
35	**Meals, beverages and soft drinks consumed in restaurants, cafés, bars, tents, and taverns**											
36	Full meals	mt							11.11.28			
37	Beer	mt							11.11.31			
38	Soft drinks	mt							11.11.37			
39		mt										
40		mt										
41		mt										
42		mt										
43	**Local transportation and communication expenses**											
44	City public transportation	mt							07.32.01			
45	Phone card	mt							07.32.03			
46	Cell phone reload (prepaid)	mt							08.30.22			
45		mt										

Reference number | | | | | | | | |

AUTO-CONSUMPTION

DAY: Nº **Date** ____/____/____

If you consumed today any product produced by your family household (family garden, eggs from your hens, firewood collected, etc.) specify the type of produced and amount consumed.

	TYPE OF PRODUCT CONSUMED	local unit	Quant.	To be filled in by interviewer Standard unit	Quant. In standard unit	Unit price (Mts)	Value (Mts)	To be filled in by coder Product code	Local unit code	Standard unit code
1	2	3	4	5	6	7	8	9	10	11
2	Corn in grain			kg				01.11.21		2
3	Sorghum in grain			kg				01.11.32		2
4	Common rice in grain			kg				01.11.12		2
5	Fresh manioc			kg				01.17.82		2
6	Dried manioc			kg				01.17.83		2
7	Sweet potato			kg				01.17.81		2
8	Tomato			kg				01.17.31		2
9	Peanuts			kg				01.16.74		2
10	Cashews			kg				01.16.73		2
11	Manioc leaves			kg				01.17.13		2
12	Sweet potato leaves			kg				01.17.14		2
13	*Nhemba* bean leaves			kg				01.17.15		2
14	Pumpkin vine leaves			kg				01.17.12		2
15	*Cacana*			kg				01.17.16		2
16	*Nhemba* beans			kg				01.17.52		2
17	Butter beans			kg				01.17.51		2
18	Chicken and other live fowl			Un				01.12.79		2
19	Fresh hen eggs			Un				01.14.71		2
20	Hunted meat			kg				01.12.72		2
21	Coconut			Unit				01.16.76		2
22										
24										
25										

RECEIVED IN KIND FROM WORK

If you have received any product from your work .

	Type of product received	Source	Amount is for how many days?	Local unit	Quant.	To be filled in by interviewer Standard unit	Quant. In standard unit	Unit price (Mts)	Value (Mts)	To be filled in by coder Product code	Local unit code	Standard unit code
1	2	3	4	5	6	7	8	9	10	11	12	13
2												
3												
4												
5												
6												
7												
8												
9												

For source: Company = 1; Government = 2; Church = 3; NGO = 4; Others =5

What was your breakfast ?	What was your lunch?	What was your snack?	What was your dinner?
Describe	Describe	Describe	Describe

Reference Number

QUESTIONNAIRE __________ OF __________

INSTITUTO NACIONAL DE ESTATÍSTICA

IOF 2008/9
INQUÉRITO SOBRE ORÇAMENTO FAMILIAR

CONFIDENTIAL

HOUSEHOLD BUDGET SURVEY - IOF 2008/9
FAMILY HOUSEHOLD QUESTIONNAIRE

IDENTIFICATION

PROVINCE ____________________

DISTRICT ____________________

ADMINISTRATIVE POST

LOCALITY

NAME OF TOWN/NEIGHBORHOOD

COMMUNITY UNIT

URBAN / RURAL (URBAN = 1, RURAL = 2) ____________________

NAME OF CENSUS AREA

NUMBER OF CENSUS AREA IOF-ID

NUMBER OF FAMILY UNIT

NAME OF HEAD OF HOUSEHOLD

VISITS OF THE INTERVIEWER

	1	2	3	FINAL VISIT
DATE	___/___ DAY / MONTH	___/___ DAY / MONTH	___/___ DAY / MONTH	DAY MONTH YEAR 2 0 0
NAME OF INTERVIEWER				CODE
RESULTS*	______	______	______	RESULTS
NEXT VISIT: DATE	______	______	______	TOTAL NUMBER OF VISITS
TIME	______	______	______	

* **CODES FOR RESULTS OF FAMILY HOUSEHOLD QUESTIONNAIRE**

01 COMPLETE
02 INCOMPLETE
03 ENTIRE FAMILY HOUSEHOLD ABSENT
04 REFUSAL DURING VISIT
05 TOTAL REFUSAL
96 OTHER
(SPECIFY)

TOTAL OF MEMBERS IN HH:

RELIGION OF HEAD OF HOUSEHOLD: ____________________

	CONTROLLER	SUPERVISOR:	REVIEWED IN OFFICE BY:	ENTERED BY:
NAME	______	______		RE-ENTERED BY:
DATE	___/___	___/___	___/___	

CONFIDENTIALITY AND STATISTICAL AUTHORITY ----- LAW 7/96 (July 5)

ART. 6: STATISTICAL AUTHORITY - The principle of statistical authority consists of the power given to the National Statistics Institute, in the conduct of statistical activities, to do surveys with compulsory responses in the periods established, and to take necessary steps for the production of statistics.

ART. 14: STATISTICAL CONFIDENTIALITY -- All statistical information of an individual nature that is collected by the official statistics producing agencies in the framework of the National Statistics Institute, is highly confidential.

Reference number

FAMILY HOUSEHOLD MODULE

Now I'd like to get some information about the people who usually live in your house.

ORDER Nº	HABITUAL RESIDENTS	RELATION-SHIP TO HEAD OF HOUSEHOLD	SEX	AGE	NATIONALITY	DISTRICT WHERE BORN	FOR PERSONS BORN OUTSIDE THE DISTRICT OF THE INTERVIEW			
	Please give me the names of the people who usually live in this house, starting with the head of the household.	What is the relationship between (NAME) and the head of the household?	Is (NAME) a man or a woman?	How old was (NAME) on the last birthday?	What is the nationality of (NAME)?	In which District was (NAME) born?	How many years has (NAME) lived in this District? ENTER "00" IF LESS THAN 1 YEAR ENTER 98 IF LIVED HERE ALWAYS AND SKIP TO 10A	In which District did (NAME) live before moving here?	What was the main reason why (NAME) came to live in this District?	In the last 12 months did (NAME) travel or sleep away from the usual location?
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(10A)
			M F	IN YEARS						YES NO
01		0 1	1 2							1 2
02			1 2							1 2
03			1 2							1 2
04			1 2							1 2
05			1 2							1 2
06			1 2							1 2
07			1 2							1 2
08			1 2							1 2
09			1 2							1 2
10			1 2							1 2

CODES FOR Q.3: RELATIONSHIP TO THE HEAD OF HOUSEHOLD

01 = HEAD
02 = HUSBAND/WIFE
03 = SON/DAUGHTER
04 = FATHER OR MOTHER
05 = STEPCHILD
06 = SON- OR DAUGHTER-IN-LAW
07 = GRANDSON/GRANDDAUGHTER
08 = BROTHER/SISTER
09 = BROTHER- OR SISTER-IN-LAW
10 = NIECE/NEPHEW
11 = OTHER RELATIVE
12 = UNRELATED

CODES FOR Q.6

1. MOZAMBICAN
2. FOREIGNER

CODES FOR Q.10

1 = FOR WORK
2 = FOR MARRIAGE
3 = TO STUDY
4 = TO JOIN THE FAMILY
5 = OTHERS (specify)

Reference number

ONLY FOR PERSONS AT LEAST FIVE YEARS OLD

ORDER NUMBER	MARITAL STATUS	MIGRATION IN LAST 5 YEARS	TIME OF LAST MIGRATION	MONTHS ABROAD	DESTINATION COUNTRY	REASON FOR MIGRATION	PRINCIPAL OCCUPATION ABROAD	REASON RETURNED TO COUNTRY
	ONLY FOR PERSONS AT LEAST 12 YEARS OLD What is your marital status?	In the last 5 years was (NAME) abroad for longer than one month?	In what year did (NAME) go abroad the last time?	That last time how many months did (NAME) stay abroad? ENTER 99 IF STILL ABROAD	That last time what country was (NAME) in?	What was the main reason why (NAME) went abroad? IF 1 TO 6 SKIP TO Q.17	What was his or her main occupation in that country? That is, (What was the principal job in the workplace?) *INTERVIEWER: DESCRIBE THE JOB IN AT LEAST 2 WORDS. DO NOT WRITE IN THE BOXES*	What was the main reason why (NAME) returned to the country?
(1)	(11)	(12)	(13)	(14)	(15)	(15A)	(16)	(17)
01		Y 1 N 2 Q.18					INTERNAL USE	
02		1 2 Q.18					INTERNAL USE	
03		1 2 Q.18					INTERNAL USE	
04		1 2 Q.18					INTERNAL USE	
05		1 2 Q.18					INTERNAL USE	
06		1 2 Q.18					INTERNAL USE	
07		1 2 Q.18					INTERNAL USE	
08		1 2 Q.18					INTERNAL USE	
09		1 2 Q.18					INTERNAL USE	
10		1 2 Q.18					INTERNAL USE	

CODES FOR Q.11
1. SINGLE
2. MARRIED
3. MONOGAMOUS MARITAL UNION
4. POLYGAMOUS MARITAL UNION
5. DIVORCED/ SEPARATED
6. WIDOWED

CODES FOR Q.15
01 = SOUTH AFRICA
02 = SWAZILAND
03 = ZIMBABWE
04 = MALAWI
05 = TANZANIA
06 = ZAMBIA
07= LESOTHO
08= NAMIBIA
09= BOTSWANA
10= OTHER

CODES FOR Q.15A
1 = MARRIAGE
2 = TO LOOK FOR WORK
3 = VACATION
4 = STUDIES
5 = MEDICAL TREATMENT
6 = TO VISIT FAMILY
7 = WORK

CODES FOR Q.17
1 = DID NOT FIND WORK
2 = TEMPORARY WORK
3 = FAMILY REASONS
4 = DID NOT PLAN TO STAY
5 = FOR MARRIAGE
6 = FOR STUDIES
7 = REMAINS ABROAD
8 = OTHERS (specify)

Reference number

ORDER Nº	SURVIVAL OF PARENTS AND RESIDENCE OF MINORS UNDER 18 YEARS OLD		EDUCATION					
			ONLY FOR PERSONS AT LEAST FIVE YEARS OLD					
	Where does the biological mother of (NAME) live? IF IN THIS HH, RECORD MOTHER'S ORDER NUMBER	Where does the biological father of (NAME) live? IF IN THIS HH, RECORD FATHER'S ORDER NUMBER	Can (NAME) read and write?	Did (NAME) ever go to school?	ONLY FOR PERSONS AGED 5 TO 24 How old was (NAME) when starting school? IF NOT KNOWN, ENTER "98"	What was the highest level of education attended by (NAME)? What was the highest class that (NAME) finished? What was the highest grade that (NAME) finished at that level?	Is (NAME) currently studying?	During the current academic year, what level and class/grade does (NAME) attend?
	(18)	(19)	(20)	(21)	(22)	(23)	(24)	(25)
	CODE NUM. Mother	CODE NUM. Father	Y N NR	YES NO	YEARS COMPLETED	LEVEL CLASS/GRADE	YES NO	LEVEL CLASS/GRADE
01			1 2 8	1 2 → Q.32			1 2 → Q.29	
02			1 2 8	1 2 → Q.32			1 2 → Q.29	
03			1 2 8	1 2 → Q.32			1 2 → Q.29	
04			1 2 8	1 2 → Q.32			1 2 → Q.29	
05			1 2 8	1 2 → Q.32			1 2 → Q.29	
06			1 2 8	1 2 → Q.32			1 2 → Q.29	
07			1 2 8	1 2 → Q.32			1 2 → Q.29	
08			1 2 8	1 2 → Q.32			1 2 → Q.29	
09			1 2 8	1 2 → Q.32			1 2 → Q.29	
10			1 2 8	1 2 → Q.32			1 2 → Q.29	

CODES FOR Q.18 AND Q.19

1 = IN THIS FAMILY HOUSEHOLD
2 = OUTSIDE THIS FAMILY HOUSEHOLD
3 = DECEASED

CODES FOR Q.23

EDUCATIONAL LEVEL

00 = LITERACY
01 = PRIMARY EP1 (1ST/5TH GRADE)
02 = PRIMARY EP2 (6TH/7TH GRADE)
03 = SECONDARY ESG1 (8TH/10TH GRADE)
04 = SECONDARY ESG2 (11TH/12TH GRADE)
05 = ELEMENTARY TECHNICAL
06 = BASIC TECHNICAL
07 = MEDIUM TECHNICAL
08 = NORMAL SCHOOL
09 = UNIVERSITY
98 = NOT KNOWN

CLASS OR GRADE: Q.25

00 = LESS THAN 1ST CLASS/GRADE: (ONLY FOR Q.23 . THIS CODE IS NOT VALID FOR Q.25)
98 = NOT KNOWN

Reference number

OR-DER Nº	In what year did (NAME) start to attend this level?	Who operates the school where (NAME) is now studying?	Does (NAME) currently have any of the following problems with school? SKIP TO Q. 30 (ALLOW MULTIPLE ANSWERS)	Why is (NAME) not studying at present?	Did (NAME) attend school in the last 12 months?	In the past 12 months, how much did (NAME) spend on: Tuition and tips (In Mt)	Textbooks (In Mt)	School uniform (In Mt)	School transport. (In Mt)
	(26)	(27)	(28)	(29)	(30)	(31A)	(31B)	(31C)	(31D)
			N LM LB BF B LU T O		YES NO				
01			01 02 03 05 06 07 08 96		1 2 → Q.32				
02			01 02 03 05 06 07 08 96		1 2 → Q.32				
03			01 02 03 05 06 07 08 96		1 2 → Q.32				
04			01 02 03 05 06 07 08 96		1 2 → Q.32				
05			01 02 03 05 06 07 08 96		1 2 → Q.32				
06			01 02 03 05 06 07 08 96		1 2 → Q.32				
07			01 02 03 05 06 07 08 96		1 2 → Q.32				
08			01 02 03 05 06 07 08 96		1 2 → Q.32				
09			01 02 03 05 06 07 08 96		1 2 → Q.32				
10			01 02 03 05 06 07 08 96		1 2 → Q.32				

CODES FOR Q.25

EDUCATIONAL LEVEL

00 = LITERACY
01 = PRIMARY EP1
02 = PRIMARY EP2
03 = SECONDARY ESG1
04 = SECONDARY ESG2
05 = ELEMENTARY TECHNICAL
06 = BASIC TECHNICAL
07 = MEDIUM TECHNICAL
08 = NORMAL SCHOOL
09 = UNIVERSITY
98 = NOT KNOWN

CODES FOR Q.27

1 = GOVERNMENT
2 = CHURCH
3 = PRIVATE
4 = COMMUNITY/NGO
6 = OTHERS

CODES FOR Q.28

01 = NONE (N)
02 = LACK OF MATERIAL (LM)
03 = LACK OF BOOKS (LB)
04 = LACK OF TEACHERS (LT)
05 = BETTER PHYSICAL FACILITIES (BF)
06 = BRIBERY (B)
07 = LACK OF UNIFORM (LU)
08 = TIPS (T)
96 = OTHER PROBLEMS (O)

CODES FOR Q.29

01 = REACHED DESIRED LEVEL
02 = NEXT LEVEL NONEXISTENT
03 = NO ROOM
04 = THE SCHOOL IS TOO FAR
05 = IT'S VERY EXPENSIVE
06 = IT'S VERY NEW
07 = WORKING (AT HOME OR IN SERVICE)
08 = NOT WORTH IT/LACK OF INTEREST
09 = FAILED
10 = MARRIED
11 = PREGNANCY
12 = OTHERS

Reference number

OR-DER Nº	HEALTH						
	Does (NAME) have any of the following handicaps? (ALLOW MULTIPLE ANSWERS)	Has (NAME) been ill or been injured in the last 2 weeks?	How many days did (NAME) miss work or school because of the illness or injury?	Did (NAME) visit a health practitioner/ institution or healer in the last 2 weeks?	What type of practitioner did (NAME) see?	Did (NAME) have any of the following problems during the visit? (ALLOW MULTIPLE ANSWERS)	Why didn't (NAME) visit a doctor in the last two weeks? (ALLOW MULTIPLE ANSWERS)
	(32)	(33)	(34)	(35)	(36)	(37)	(38)
	N B M DM MR P AA AL O	Y N	DAYS	Y N		N LH WT QP TE LY UT C O	N TE TF LT O
01	01 02 03 04 05 06 07 08 96	1 2 Q.39		1 2 Q.38		01 02 03 04 05 06 07 08 96	1 2 3 4 5
02	01 02 03 04 05 06 07 08 96	2 1 Q.39		1 2 Q.38		01 02 03 04 05 06 07 08 96	1 2 3 4 5
03	01 02 03 04 05 06 07 08 96	2 1 Q.39		1 2 Q.38		01 02 03 04 05 06 07 08 96	1 2 3 4 5
04	01 02 03 04 05 06 07 08 96	2 1 Q.39		1 2 Q.38		01 02 03 04 05 06 07 08 96	1 2 3 4 5
05	01 02 03 04 05 06 07 08 96	2 1 P39		1 2 Q.38		01 02 03 04 05 06 07 08 96	1 2 3 4 5
06	01 02 03 04 05 06 07 08 96	2 1 Q.39		1 2 Q.38		01 02 03 04 05 06 07 08 96	1 2 3 4 5
07	01 02 03 04 05 06 07 08 96	2 1 Q.39		1 2 Q.38		01 02 03 04 05 06 07 08 96	1 2 3 4 5
08	01 02 03 04 05 06 07 08 96	2 1 Q.39		1 2 Q.38		01 02 03 04 05 06 07 08 96	1 2 3 4 5
09	01 02 03 04 05 06 07 08 96	2 1 Q.39		1 2 Q.38		01 02 03 04 05 06 07 08 96	1 2 3 4 5
10	01 02 03 04 05 06 07 08 96	2 1 Q.39		1 2 Q.38		01 02 03 04 05 06 07 08 96	1 2 3 4 5

CODES FOR Q.32
01 = NONE (N)
02 = BLIND (B)
03 = MUTE (M)
04 = DEAF MUTE (DM)
05 = MENTAL RETARDATION (MR)
06 = PARALYTIC (P)
07 = AMPUTATED/ATROPHIED ARM (AA)
08 = AMPUTATED/ATROPHIED LEG (AL)
96 = OTHER (O), SPECIFY

CODES FOR Q.36
01 = GOVERNMENT HEALTH POST
02 = GOVERNMENT HEALTH CENTER
03 = HOSPITAL (RURAL, CENTRAL, GEN., PROV.)
04 = PRIVATE CLINIC
05 = PHARMACY
06 = DOCTOR/DENTIST/PRIVATE OFFICE
07 = HEALER
8. CHURCH

CODES FOR Q.37
01 = NONE(N)
02 = LACK OF HYGIENE (LH)
03 = LONG WAITING TIME (WT)
04 = LACK OF QUALIFIED PERSONS (QP)
05 = TOO EXPENSIVE (TE)
06 = LACK OF MEDICINE (LM)
07 = UNSUCCESSFUL TREATMENT (UT)
08 = CORRUPTION (C)
96 = OTHER (O), SPECIFY

CODES FOR Q.38
1 = WAS NOT NECESSARY(NN)
2 = TOO EXPENSIVE (TE)
3 = TOO FAR (TF)
4. LACK OF TRANSPORTATION (LT)
5 = OTHER (O), SPECIFY.

Pag.6

Reference number

OR-DER Nº	HEALTH					
	How many times did you visit a doctor or health technicians in the public sector in the last 30 days? IF NO VISIT SKIP TO Q.39B	How much did you pay for the public sector health visit in the last 30 days? (In Mts)	How many times did you visit a doctor or health technicians in the private sector in the last 30 days? IF NO VISIT SKIP TO Q.39B	How much did you pay for the private sector health visit in the last 30 days? (In Mts)	How many times did you visit a traditional doctor (healer) in the last 30 days? IF NO VISIT SKIP TO Q.40	How much did you pay for the healer visit in the last 30 days? (In Mts)
	(39)	(39A)	(39B)	(39C)	(39D)	(39E)
01						
02						
03						
04						
05						
06						
07						
08						
09						
10						

Reference number

ORDER Nº	ONLY FOR PERSONS AT LEAST 7 YEARS OLD						
	Did (NAME) work in the last 7 days? (worked on the small farm, sold some product, or did some other economic activity in the last 7 days?)	Even if (NAME) did not work in the last 7 days, does he or she have some job, farm, company, or business where he or she did not work in the last 7 days, and to which he or she will return to work?	Was (NAME) available for work in the last 7 days?	Why was (NAME) not available for work in the last 7 days?	In the last 30 days did (NAME) do something to look for work?	What did (NAME) do to look for work in the last 30 days?	In the last 12 months did (NAME) work on the small farm, fetch wood/ water, help some household member with their business or do any work that was paid for with money or in kind?
	(40)	(41)	(42)	(43)	(44)	(45)	(45A)
01	Y N 1 2 P.46	Y N 1 2 P.46	S N 1 2 Q.44		Y N Unk 1 2 3 Q.45A		Y N 1 2 NEXT PERSON
02	1 2 P.46	1 2 P.46	1 2 Q.44		1 2 3 Q.45A		1 2 NEXT PERSON
03	1 2 P.46	1 2 P.46	1 2 Q.44		1 2 3 Q.45A		1 2 NEXT PERSON
04	1 2 P.46	1 2 P.46	1 2 Q.44		1 2 3 Q.45A		1 2 NEXT PERSON
05	1 2 P.46	1 2 P.46	1 2 Q.44		1 2 3 Q.45A		1 2 NEXT PERSON
06	1 2 P.46	1 2 P.46	1 2 Q.44		1 2 3 Q.45A		1 2 NEXT PERSON
07	1 2 P.46	1 2 P.46	1 2 Q.44		1 2 3 Q.45A		1 2 NEXT PERSON
08	1 2 P.46	1 2 P.46	1 2 Q.44		1 2 3 Q.45A		1 2 NEXT PERSON
09	1 2 P.46	1 2 P.46	1 2 Q.44		1 2 3 Q.45A		1 2 NEXT PERSON
10	1 2 P.46	1 2 P.46	1 2 Q.44		1 2 3 Q.45A		1 2 NEXT PERSON

CODES FOR Q.43

01. WENT TO SCHOOL
02. NOT PREPARED TO PAY HOUSEHOLD HELP
03. CARING FOR PEOPLE WHO NEEDED HELP
04. FORBIDDEN TO WORK BY HUSBAND
05. FORBIDDEN TO WORK BY WIFE
06. TOO YOUNG
07. TOO OLD
08. WAS SICK
09. WAS HANDICAPPED
10. REFORMED
11. COMPULSORY MILITARY SERVICE
12. OTHER (SPECIFY)

CODES FOR Q.45

01. REGISTERED AT EMPLOYMENT CENTERS
02. CONTACTED FARM OWNERS
03. CONTACTED FACTORIES OR OTHER SERVICES
04. CONTACTED FRIENDS AND FAMILY MEMBERS
05. CHECKED NEWSPAPER ADS
06. SOUGHT FINANCING
07. OTHER (SPECIFY)

Reference number

OR-DER Nº	ONLY FOR PERSONS AT LEAST 7 YEARS OLD			
	What is your primary occupation? (That is, what is your main job where you work?)	Who did (NAME) work for at his or her main occupation?	Is (NAME) a permanent, seasonal, or occasional worker?	Describe the principal economic activity at the place where (NAME) works.
	(46)	(47)	(48)	(49)
01	INTERNAL USE			INTERNAL USE
02	INTERNAL USE			INTERNAL USE
03	INTERNAL USE			INTERNAL USE
04	INTERNAL USE			INTERNAL USE
05	INTERNAL USE			INTERNAL USE
06	INTERNAL USE			INTERNAL USE
07	INTERNAL USE			INTERNAL USE
08	INTERNAL USE			INTERNAL USE
09	INTERNAL USE			INTERNAL USE
10	INTERNAL USE			INTERNAL USE

CODES FOR Q.47

01. GOVERNMENT
02. PUBLIC SECTOR
03. PRIVATE SECTOR
04. SELF-EMPLOYED WITH EMPLOYEES
05. SELF-EMPLOYED WITHOUT EMPLOYEES
06. UNPAID FAMILY WORKER
07. PRIVATE PERSON/GROUP
08. COOPERATIVE SECTOR
09. NGO AND OTHER ASSOCIATIONS

CODES FOR Q.48

01. PERMANENT WORKER
02. SEASONAL WORKER
03. OCCASIONAL WORKER

Reference number

ORDER Nº	ONLY FOR PERSONS AT LEAST 7 YEARS OLD					
	Is (NAME) a salaried worker?	How many hours does (NAME) work per week?	How many months did (NAME) work in the last 12 months?	How much did (NAME) get in his last pay? (In Mts)	Is this salary daily, weekly, or monthly?	In addition to the salary, what was the value **(of rent, food, transportation, etc.)** received by (NAME) in the last month?
	(50)	**(51)**	**(52)**	**(53)**	**(54)**	**(55)**
	Y N	**HOURS**	**MONTHS**			
01	1 2 → Q.56					
02	1 2 → Q.56					
03	1 2 → Q.56					
04	1 2 → Q.56					
05	1 2 → Q.56					
06	1 2 → Q.56					
07	1 2 → Q.56					
08	1 2 → Q.56					
09	1 2 → Q.56					
10	1 2 → Q.56					

CODES FOR Q.54
1 DAILY
2 WEEKLY
3 MONTHLY

Reference number

ORDER Nº	ONLY FOR PERSONS AT LEAST 7 YEARS OLD					
	Did (NAME) work in more than one economic activity?	Why did (NAME) work in more than one economic activity?	What is the occupation of (NAME) in this other economic activity? That is, (What are his or her principal duties in this other activity?)	Who did (NAME) work for in this other job?	In this other activity is (NAME) a permanent, seasonal, or occasional worker?	Describe the principal economic activity at that workplace where (NAME) did this other activity?
	(56)	(57)	(58)	(59)	(60)	(61)
01	Y 1 / N 2 → P.67A		INTERNAL USE			INTERNAL USE
02	S 1 / N 2 → P.67A		INTERNAL USE			INTERNAL USE
03	S 1 / N 2 → P.67A		INTERNAL USE			INTERNAL USE
04	S 1 / N 2 → P.67A		INTERNAL USE			INTERNAL USE
05	S 1 / N 2 → P.67A		INTERNAL USE			INTERNAL USE
06	S 1 / N 2 → P.67A		INTERNAL USE			INTERNAL USE
07	S 1 / N 2 → P.67A		INTERNAL USE			INTERNAL USE
08	S 1 / N 2 → P.67A		INTERNAL USE			INTERNAL USE
09	S 1 / N 2 → P.67A		INTERNAL USE			INTERNAL USE
10	S 1 / N 2 → P.67A		INTERNAL USE			INTERNAL USE

CODES FOR Q.57

01. HAS OCCASIONAL OR SEASONAL WORK
02. TO GET MORE INCOME
03. WORKED LESS THAT DESIRED
04. OTHER (SPECIFY)

CODES FOR Q.59

01. GOVERNMENT
02. PUBLIC SECTOR
03. PRIVATE SECTOR
04. SELF-EMPLOYED WITH EMPLOYEES
05. SELF-EMPLOYED WITHOUT EMPLOYEES
06. UNPAID FAMILY WORKER
07. PRIVATE PERSON/GROUP
08. COOPERATIVE SECTOR
09. NGO AND OTHER ASSOCIATIONS

CODES FOR Q.60

01. PERMANENT WORKER
02. SEASONAL WORKER
03. OCCASIONAL WORKER

Reference number

ORDER Nº	ONLY FOR PERSONS AT LEAST 7 YEARS OLD In that other activity:					
	Is (NAME) a salaried worker?	How many hours does (NAME) work per week?	How many months did (NAME) work in the last 12 months?	How much did (NAME) get in his last pay? (In Mts)	Is this salary daily, weekly, or monthly?	In addition to the salary, what was the value **(of rent, food, transportation, etc.)** received by (NAME) in the last month?
	(62)	**(63)**	**(64)**	**(65)**	**(65A)**	**(66)**
01	Y 1 N 2 → Q.67A					
02	1 2 → Q.67A					
03	1 2 → Q.67A					
04	1 2 → Q.67A					
05	1 2 → Q.67A					
06	1 2 → Q.67A					
07	1 2 → Q.67A					
08	1 2 → Q.67A					
09	1 2 → Q.67A					
10	1 2 → Q.67A					

CODES FOR Q.65A
1 DAILY
2 WEEKLY
3 MONTHLY

Reference number

OR-DER Nº	ONLY FOR PERSONS AT LEAST 7 YEARS OLD					
	In the last 7 days, how many hours did (NAME)					
	(a) Work on the farm, including livestock or fishing, both for sale and for household consumption?	(b) Fetch firewood or water for the household?	(c) Engage in any economic activity besides self-employed farming or fishing?	(d) Help some household member in their activity besides self-employed farming or fishing?	(e) Do any work paid in money or in kind, including occasional work?	How many hours did (NAME) spend **yesterday** cooking, doing laundry, house cleaning or other similar activities?
	(67A)	**(67B)**	**(67C)**	**(67D)**	**(67E)**	**(68)**
01						
02						
03						
04						
05						
06						
07						
08						
09						
10						

Reference number

HOUSING CHARACTERISTICS AND CONDITIONS

No	QUESTIONS AND FILTERS	CODE OF THE CATEGORIES		SKIP TO
70	Type of housing	CONVENTIONAL HOUSE	1	
		FLAT/APARTMENT	2	
		STRAW HOUSE.....	3	
		MIXED HOUSE	4	
		IMPROVISED HOUSE	5	
		BASIC HOUSE	6	
		PART OF COMMERCIAL BUILDING	7	
		OTHER (SPECIFY) ______	8	
71	The house is:	OWNED	1	
		RENTED	2	→ Q.73
		LENT, BORROWED TEMPORARILY	3	→ Q.73
		OTHER ______	4	
72	If house is owned, how was it obtained?	SELF CONSTRUCTION.....	1	
		BOUGHT FROM APIE [state housing agency].....	2	
		BOUGHT FROM OTHERS	3	
		INHERITED.....	4	
		OTHER (specify) ______	6	
73	The house walls are made of:	CEMENT BLOCKS	1	
		BRICKS	2	
		WOOD/ZINC	3	
		ADOBE BLOCKS	4	
		CANE/STICKS/BAMBOO/PALM.....	5	
		WATTLE.....	6	
		TIN/CARDBOARD/PAPER/SACK/SHELL.....	7	
		OTHER (specify) ______	8	
74	The house is covered with:	CONCRETE SLABS	1	
		STRAW.....	2	
		LUSALITE SHEETS	3	
		ZINC SHEETS.....	4	
		GRASS/THATCH/PALM.....	5	
		OTHER (specify) ______	6	
75	The floor of the house (excluding kitchen and bath) is made of:	WOOD/PARQUET.....	1	
		MARBLE/GRANULITE.....	2	
		CEMENT.....	3	
		MOSAIC/TILE.....	4	
		ADOBE(BEATEN EARTH).....	5	
		UNCOVERED.....	6	
		OTHERS (specify) ______	7	
76	How many rooms does the house have (excluding kitchen and bath):	ROOMS	☐☐	
77	Of these rooms, how many are used for sleeping?	ROOMS	☐☐	
78	What is the primary source of drinking water for this household?	PIPED WATER IN THE HOUSE.....	01	
		PIPED WATER OUTSIDE THE HOUSE/YARD.....	02	
		SPRINGWATER.....	03	
		WELL WATER WITH HAND PUMP	04	
		WELL WATER WITHOUT PUMP.....	05	
		WATER FROM RIVER/LAKE/POND.....	06	
		RAINWATER.....	07	
		MINERAL WATER/BOTTLED WATER.....	08	
		OTHER (specify) ______	09	
79	Does this household treat water before drinking it?	YES.....	1	
		NO	2	→ Q.81
		NOT KNOWN.....	3	→ Q.81
80	How does this household treat water for drinking?	BOILING.....	1	
		ADDING BLEACH, CHLORINE, SODA.....	2	
		FILTERING WITH A CLOTH.....	3	
	ALLOW MULTIPLE ANSWERS	ADDING *CERTEZA*.	4	
		OTHERS (specify) ______	5	

Pag. 14

Reference number

HOUSING CHARACTERISTICS AND CONDITIONS

No	QUESTIONS AND FILTERS	CODE OF THE CATEGORIES	SKIP TO
81	What is the distance you travel on foot to the source where you get water, and how long does it take to get there, draw water, and return?	IT IS ON SITE.......... 0 METERS .... DON'T KNOW (DISTANCE IN METERS).......... 99998 MINUTES .... DON'T KNOW (TIME IN MINUTES) 998	
82	How much time in minutes does it take to walk from your house to the nearest (NAME OF FACILITY)? INTERVIEWER: IF INTERVIEWEE DOES NOT KNOW THE TIME ENTER CODE 998. AND IF FACILITY DOES NOT EXIST USE CODE 999.	A. Drinking water source B. Market, grocery C. Bus stop D. Primary school C. Health unit E. Police post	
83	A casa tem:	TOILET CONNECTED TO SEPTIC FIELD.......... 1 IMPROVED LATRINE.......... 2 IMPROVED TRADITIONAL LATRINE.......... 3 UNIMPROVED LATRINE.......... 4 NO TOILET/LATRINE.......... 5	
84	What is the primary source of energy or fuel that the family household uses for cooking? (For example: charcoal, wood, gas, etc.)	ELECTRICITY.......... 01 GAS .... 02 OIL/PARAFFIN/KEROSENE .... 03 CHARCOAL .... 04 COAL .... 05 WOOD.......... 06 ANIMAL FECES.......... 07 OTHER (SPECIFY) __________ 96	
85	What is the primary source of energy used for lighting this house?	ELECTRICITY.......... 01 GENERATOR/SOLAR PANEL.......... 02 GAS.......... 03 OIL/PARAFFIN/KEROSENE .... 04 CANDLES.......... 05 BATTERY.......... 06 WOOD.......... 07 OTHER (SPECIFY) __________ 08	

Reference number | | | | | | | | |

FARMING AND LIVESTOCK RAISING

A. Area of farms

86. Did some member of this household have their own or leased farms, orchards, or plantations in the 2007/2008 season? 1-Yes 2-No >> Q.109 |______|

	(87)	(88)	(89)	(90)	(91)	(92)	(93)
	Location of the farms, plantations, orchards	How did you get this farm? SEE CODES	Total hectares in this farm? HECTARES	Total **cultivated** area in the farm? IF CULTIVATED AREA EQUALS TOTAL AREA >> 92 HECTARES	Why did you not cultivate this farm or cultivate less than the total area? 1. Rent to others 2. Left fallow 3. Lacked labor 4. Lack of resources 5. Others (specify)	Is the farm in the upper or lower zone? 1. UPPER 2. LOWER	Does this farm use an irrigation system? 1. yes, manual 2. yes, mechanized 3. yes, gravity 4. yes, simple pump 5. No
1			__ __ . __	__ __ . __			
2			__ __ . __	__ __ . __			
3			__ __ . __	__ __ . __			
4			__ __ . __	__ __ . __			
5			__ __ . __	__ __ . __			

CODES FOR Q.88
(HOW YOU GOT THE FARM)

1 Given by traditional authorities
2 Given by formal authorities
3 Given by relatives
4 Leased
5 Borrowed
6 Occupied
7 Purchased with title
8 Purchased without title
9 Inherited
10 Others (specify)

Agricultural production

***Interviewer**: The information we want to collect refers to the last full farm season.*

No.	(94)	(95)		(97)	(98)	(99)	(100)	(101)	(102)	(103)	(104)	(105)
	*Please list all of the crops raised in this **last full farm season.***	CODE		HARVEST VOLUME Quantity	Unit	Condition	Did you sell the crop? 1 Yes 2 No >> *next crop*	VOLUME SOLD Quantity	Unit	Condit.	FILL IN ONLY ONE Value of the sale	Price for unit sold
Basic food crops and cash crops												
1												
2												
3												
4												
5												
6												
7												
Vegetables and fruit												
1												
2												
3												
4												
5												

ANNUAL BASIC CROPS	CODE	CASH CROPS	CODE	VEGETABLES	CODE	FRUIT	CODE
Corn		Cotton		Tomato		Orange	
Rice		Tobacco		Kale		Mango	
Sorghum		Sugar cane		Pumpkin		Banana	
Millet		Sunflower		Lettuce		Avocado	
Large peanuts		Sesame		Garlic		Jackfruit	
Small peanuts				Eggplant		Guava	
Butter beans				Onion		Lemon	
Nhemba beans				Carrot		Litchi	
Jugo beans				Peas		Apple	
Boer beans				Yam/Taro		Indian apple	
Manioc				Watermelon		Mafura	
Sweet potatoes				Paprika		Mango	
				Cucumber		Passionfruit	
				Pimento		Papaya	
				Piripri (birdseye)		Pear	
						Peach	

UNITS OF MEASURE				ESTADO	
	11. Bag-100kg	21. Can-25L	40. 300ml		5 Shelled
	12. Bag-90kg	22. Can-20L	41. 500ml	1 Fresh	6 Flour
1. Kg	13. Bag-70kg	23. Can-10L	42. 750mi	2 On the ear	7 Dry in pod
2. Unit	14. Bag-60kg	24. Can-5L	43. Liter	3 Grain	8 Dry
	15. Bag-50 kg	25. Can-1L	44. Gallon	4 With shell	9 Tapioca

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Reference number | | | | | | | | |

FARMING AND LIVESTOCK RAISING

INPUTS, LABOR, AND MEANS OF PRODUCTION

cod	(106)	(107) In the last full farm season did you use …? 1. Yes 2. No >> next	(108) Total amount of payment
1	Manure		
2	Chemical fertilizers		
3	Pesticide, herbicide		
4	Labor		
5	Draft animals		
6	Tractors		
7	Fuel/transportation		
8	Wagons/carts		
9	Thresher		
10	Electrical pumps		
11	…		
12	…		

Livestock raising in the last 12 months

	(109)	(110) In the last 12 months has this household raised [ANIMAL]? 1. Yes 2. No >> next animal	(111) How many (ANIMAL) does this household have today?	(112) How many (ANIMAL) were sold live in the last 12 months? If 0 >> next animal	(113) Sales price *METICAIS*	(114) Did you vaccinate animals in the meses? 1. Yes 2. No >> next	(115) Cost of vaccinations? METICAIS
81	Cattle						
82	Goats						
83	Sheep						
84	Pigs						
85	Chickens						
86	Ducks						
	Other*						

* Might be: Geese, turkeys, guinea fowl, rabbits, etc. (do not include dogs, cats, horses, and wild animals

PRODUCTS AND BYPRODUCTS

	(116)	(117) In the last 12 months did you sell …? 1. Yes 2. No >> Next	(118) Value of sale METICAIS
1	Eggs		
2	Milk		
3	Hides		
4	Beef		
5	Pork		
6	Goat meat		
7	Chicken		
8	Charcoal		
9	Honey		
10	Homemade beverages		
11	Chestnuts		
12	Almonds		
13	Coconut		
14	Copra		
15	Meat from hunting		

AREA

(119) In the last farm season did you get at least one visit from the extension agent? 1. Yes 2. No	(120) Does this household know the times and places to sell farm products? 1. Yes 2. No

Reference number | | | | | | | | |

RECENT CALAMITIES AND SHOCKS EXPERIENCED BY THE HOUSEHOLD

				ONLY FOR THE 3 MAIN EVENTS				
COD	**(121)**		**(122)**	**(123)**		**(124)**		
	In the last 5 years was this household negatively affected by one of the following events? COVER THE LIST BEFORE CONTINUING.	YES ....1 NO.........2 **(»NEXT LINE)**	Rank 3 events that were most relevant: 1 = MOST RELEVANT 2 = RELEVANT 3 = LEAST RELEVANT	How long ago did this event occur		What did you do in response or to resume your nomal life? [LIST ONLY THREE IN ORDER OF IMPORTANCE.]		
				YEARS	MONTHS	1ST	2ND	3RD
1	Flood							
2	Drought							
3	Cyclone							
4	Agricultural pests (plague)							
5	Epidemic							
6	Death or theft of cattle							
7	Bankruptcy of HH business							
8	Loss of salaried worker							
9	Low producer prices							
10	Increased prices for food							
11	Illness or accident of HH member							
12	Death of head of household							
13	Death of a worker member							
14	Death of another HH member							
15	Theft, robbery							
16								

CODES FOR Q.124

RECEIVED HELP FROM GOVERNMENT............	1
REDUCED THE AMOUNT OF FOOD..................	2
LOWERED THE QUALITY OF FOOD..................	3
CUT NON-FOOD EXPENSES..............................	4
DIDN'T DO ANYTHING...	5
OTHER (SPECIFY)_______________________	6

Reference number

POVERTY INDICATORS

No	QUESTIONS AND FILTERS	CODES FOR THE CATEGORIES	
125	How many meals did this household have yesterday?	NONE	1
		ONE	2
		TWO	3
		THREE	4
126	In which months did this household have problems with food in the last 12 months?	JANUARY	1
		FEBRUARY	2
		MARCH	3
		APRIL	4
		MAY	5
	(ALLOW MULTIPLE REPONSES)	JUNE	6
		JULY	7
		AUGUST	8
		SEPTEMBER	9
		OCTOBER	10
		NOVEMBER	11
		DECEMBER	12
		NO MONTH	13
127	During the past month, the food in this household was:	INSUFFICIENT	1
		SUFFICIENT	2
		MORE THAN SUFFICIENT	3
128	How is the household's economic condition in comparison with what it was a year ago?	MUCH WORSE NOW	1
		WORSE NOW	2
		THE SAME	3
		A LITTLE BETTER NOW	4
		MUCH BETTER NOW	5
		DON'T KNOW	6

MONETARY SECTION

No		CATEGORY CODES		SKIP TO
129	Does some member of this household have a bank account?	YES	1	→ 131
		NO	2	
130	Why don't they have a bank account?	DON'T TRUST THE BANK	1	
		THE BANK IS TOO FAR	2	
		DON'T NEED IT	3	
		OTHER (SPECIFY)	4	
131	Does this household have any of the obsolete series of Metical bills and coins?	YES..	1	
		NO	2	→ 133
132	What is the value of these obsolete Metical bills and coins that the household owns?	VALUE OF BILLS		
		VALUE OF COINS....................		
		DON'T KNOW..	98	
133	Which of the following bills of the new Metical series do you prefer to use for transactions?	1,000.00..	1	
		500.00..	2	
		200.00..	3	
		100.00..	4	
	(ALLOW MULTIPLE ANSWERS)	50.00..	5	
		20.00..	6	
134	Which of the following coins of the new Metical series do you prefer to use for transactions?	10.00..	1	
		5.00..	2	
		2.00..	3	
		1.00..	4	
	(ALLOW MULTIPLE ANSWERS)	50CT..	5	
		20CT..	6	
		10CT..	7	
		5CT..	8	
		1CT..	9	

Reference number

SECTION OF HEIGHT AND WEIGHT OF CHILDREN UNDER FIVE YEARS OF AGE

COMPARE LIST OF HOUSEHOLD MEMBERS AND NOTE THE ORDER NUMBER, NAME, AND AGE OF ALL CHILDREN UNDER FIVE YEARS OF AGE

CHILDREN UNDER 5								
ORDER Nº FROM LINE **1**	NAME FROM COLUMN **2**	AGE FROM COLUMN **5**	What is the date of birth of (NAME)?	WEIGHT (KILOGRAMS)	HEIGHT (CENTIMETERS)	MEASURED PRONE OR STANDING	RESULT 1. MEASURED 2. MISSING 3. REFUSED 6. OTHER	Did (NAME) sleep under a mosquito net last night?
	(135)	**(136)**	**(137)**	**(138)**	**(139)**	**(140)**	**(141)**	**(142)**
			DAY MONTH YEAR			PRONE STANDING		YES NO
				0 .	.	1 2		1 2
				0 .	.	1 2		1 2
				0 .	.	1 2		1 2
				0 .	.	1 2		1 2
				0 .	.	1 2		1 2
				0 .	.	1 2		1 2
				0 .	.	1 2		1 2
				0 .	.	1 2		1 2
				0 .	.	1 2		1 2
				0 .	.	1 2		1 2

FOR CHILDREN 0 TO 2 YEARS OF AGE

ORDER Nº	How soon after birth did (NAME) start nursing? IF LESS THAN ONE HOUR ENTER "00" IF NEVER NURSED CONCLUDE INTERVIEW	How many months did (NAME) only drink breast milk? IF LESS THAN ONE MONTH ENTER "00" IF NEVER GIVEN BREAST MILK ENTER "96"	Does (NAME) still drink only breast milk?	At how many months of age did (NAME) stop nursing? de mamar? IF LESS THAN ONE MONTH, ENTER "00"
	(143)	**(144)**	**(145)**	**(146)**
	CODE HOURS/DAYS	MONTHS	YES NO 1 2 Terminate	MONTHS
			1 2 Terminate	
			1 2 Terminate	

<u>CODES FOR Q.143</u>
01. IMMEDIATELY
02. HOURS
03. DAYS
96.NEVER
98 DOESN'T KNOW/DOESN'T REMEMBER

Reference number

INTERVIEWER COMMENTS

Comments about the interview:

Comments on specific questions:

Any other comment:

CONTROLLER'S COMMENTS

Name of the controller: ______________________ Date: ______________________

SUPERVISOR'S COMMENTS

Name of the Supervisor ______________________ Date: ______________________

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Reference number | | | | | | | |

INTERVIEWER: Carefully check whether or not this family household purchased the following products in the last 7 days for its consumption:

1.	2.	3.	4.	5.	6.	7.
Products	Does this household usually consume (NAME OF PRODUCT)? **1. Yes** **2. No>> Next Product**	Did this household buy (PRODUCT) in the last 7 days? 1. YES >>**Check on daily expense questionnaire and go to next product.** 2.NO	What amount was bought last time?	Purchase unit **Unit**	This amount is for how many days? **days**	Price **Meticais**
Rice						
Corn meal						
Manioc flour						
Cleaned dead chicken						
Live chicken						
Fish						
Cooking oil						
Peanuts						
Coconut						
Sugar						

Reference number

INSTITUTO NACIONAL DE ESTATÍSTICA

IOF 2008/9
INQUÉRITO SOBRE ORÇAMENTO FAMILIAR

CONFIDENTIAL

HOUSEHOLD BUDGET SURVEY - IOF 2008/9
ANNUAL AND MONTHLY EXPENSES AND INCOME

IDENTIFICATION	
PROVINCE________________________	
DISTRICT________________________	
ADMINISTRATIVE POST	
LOCALITY	
NAME OF TOWN/NEIGHBORHOOD	
COMMUNITY UNIT	
URBAN / RURAL (URBAN = 1, RURAL = 2) ________________	
NAME OF CENSUS AREA	
NUMBER OF CENSUS AREA IOF-ID	
NUMBER OF FAMILY UNIT	
NAME OF HEAD OF HOUSEHOLD	

QUESTIONNAIRE ON

ANNUAL AND MONTHLY EXPENSES

AND INCOME

Reference number | | | | | | | | |

OWNERSHIP OF DURABLE GOODS AND ANNUAL EXPENSES

Read the listed goods one by one and write the number the household possesses.
Also ask if the family bought these goods in the last 12 months and the price paid.

Type of goods	Code	How many (name of goods) do you own?	In the last 12 months: How many (name of goods) did you buy?	In the last 12 months: How much did you pay? (In Mts)
2	3	4	5	6
Car bought new	07.11.10			
Car bought used	07.11.20			
Motor scooter	07.12.01			
Bicycle	07.13.01			
Radio	09.11.13			
Stereo	09.11.12			
Television	09.11.21			
Washing machine	05.31.21			
Air conditioner	05.31.44			
Sewing machine	05.31.60			
Refrigerator	05.31.12			
Freezer	05.31.11			
Electric iron	05.32.03			
Charcoal iron				
Fan	05.32.08			
Beds (double, single, children's, and cribs)	05.11.14			
Fixed telephone	08.20.01			
Cellular telephone	08.20.04			
Computer	09.13.04			
Printer	09.13.05			
Clock (wall clock, wrist or pocket watch)	12.31.03			
Electric oven	05.31.33			
Gas oven	05.31.32			
Mixed oven	05.31.34			
Solar panel				

Reference number | | | | | | | | |

MONTHLY EXPENSES

In the last 30 days did you buy or pay for (read listed goods and services one by one)?
If so, indicate the amount purchased, price paid, and where bought.

Code	Type of goods or services	Unit of measure	Quant	Total price (In Mts)	Place of purchase Store.......................... Market.......................... Informal Market............... Other (specify)	Cod 1 2 3 4	Unit code
1	2	3	4	5	6	7	8
03.10.00	**CLOTHING**						
03.11.00	**Cloth for clothing**						
03.11.11	Cloth for slacks	m					
03.11.14	Cloth for dresses	m					
03.12.10	**Men's clothing**						
03.12.18	Complete suit	Unit					1
03.12.19	Guayabera	Unit					1
03.12.14	Shirt	Unit					1
03.12.22	Undershirt	Unit					1
03.12.24	Underpants	Unit					1
03.12.25	Shoes	Pair					1
03.12.11	Slacks	Unit					1
03.12.12	Jeans	Unit					1
03.12.30	**Women's clothing**						
03.12.39	Dresses	Unit					1
03.12.38	Skirts	Unit					1
03.12.34	Blouses	Unit					1
03.12.42	Loincloths	Unit					1
03.12.43	Underpants	Unit					1
03.13.21	Head scarves	Unit					1
03.12.50	**Children's clothing (3 to 13 years) (excluding school clothing)**						
03.12.51	Children's slacks	Unit					
03.12.52	Children's jeans	Unit					
03.12.53	Children's shoes	Unit					
03.12.54	Children's shirts	Unit					
03.12.55	Children's blouses	Unit					
03.12.57	Children's skirts	Unit					
03.12.58	Children's dresses	Unit					
03.12.59	Children's underpants	Unit					
03.12.68	Children's T-shirts	Unit					

Pag.2

Reference number | | | | | | | | |

MONTHLY EXPENSES

In the last 30 days did you buy or pay for (read listed goods and services one by one)?
If so, indicate the amount purchased, price paid, and where bought.

Code	Type of goods or services	Unit of measure	Quant	Total price (In Mts)	Place of purchase Store.................. Market.................. Informal Market....... Other (specify)	Cod 1 2 3 4	Unit code
1	2	3	4	5	6	7	8
03.10.00	**CLOTHING**						
03.12.70	**Baby clothing (0 - 2 years)**						
03.12.71	Short pants for babies	Unit					
03.12.72	Long pants for babies	Unit					
03.12.73	Baby shirts	Unit					
03.12.74	Baby T-shirts	Unit					
03.12.78	Baby dresses	Unit					
03.12.80	**Other clothing articles for babies**						
03.12.86	Baby rubber pants	Unit					
03.12.87	Cloth diapers (exclude disposables)	Unit					1
03.13.00	**Other clothing articles and accessories**						
03.13.10	**Men's clothing accessories**						
03.13.11	Hats, caps, and berets for men	Unit					
03.13.12	Belts and suspenders for men	Unit					
03.13.13	Ties	Unit					
03.13.14	Handkerchiefs	Unit					
03.13.20	**Women's clothing accessories**						
03.13.21	Head scarves, neck scarves, and shawls	Unit					
03.13.22	Hats and caps for women	Unit					
03.13.23	Belts for women	Unit					
03.13.24	Handkerchiefs	Unit					
03.13.26	Robes and aprons	Unit					
03.13.30	**Babies' and children's clothing accessories**						
03.13.31	Hats and caps for babies and children	Unit					
03.13.32	Belts for babies and children	Unit					
03.14.00	Cleaning, repair, and rental of clothing	mt					

Reference number | | | | | | | | |

MONTHLY EXPENSES

In the last 30 days did you buy or pay for (read listed goods and services one by one)?
If so, indicate the amount purchased, price paid, and where bought.

Code	Type of goods or services	Unit of measure	Quant	Total price (In Mts)	Place of purchase Store................. Market........... Informal Market..... Other (specify)	Cod 1 2 3 4	Unit code
1	2	3	4	5	6	7	8
03.20.00	**FOOTWEAR**						
03.21.11	Men's shoes	Pair					4
03.21.16	Other types of men's footwear	Pair					
03.21.21	Women's shoes	Pair					4
03.21.26	Other types of women's footwear	Pair					
03.21.31	Children's shoes	Pair					4
03.21.36	Other types of children's footwear	Pair					
03.21.41	Babies' shoes	Pair					4
03.21.46	Other types of babies' footwear	Pair					
03.22.00	Repair and rental of shoes	mt					
04.00.00	**UTILITIES, WATER, ELECTRICITY, GAS, AND OTHER FUELS**						
04.10.00	Actual cost of the housing	mt					
04.20.00	Nominal cost of the housing	mt					
04.31.00	**Material for maintenance and repair of the housing**						
04.31.01	Paint	Liter					
04.31.02	Cement	50 Kg					
04.31.06	Window glass	mt					
04.31.09	Other material for repair and maintenance of the housing (includes scrap material)	mt					
04.32.00	**Services for maintenance and repair of the housing**						
04.32.01	Plumbing services	mt					
04.32.02	Electrician services	mt					
04.32.09	Other services for repair and maintenance of the housing	mt					
04.41.00	**WATER SUPPLY (S)**						
04.41.01	Consumption of piped water	mt					
04.41.03	Consumption of unpiped water	mt					
04.42.00	Refuse collection	mt					
04.44.00	**Other services related to housing**						
04.44.01	Concierge and guard services (security)	mt					
04.44.05	Other unspec. services related to housing	mt					
04.51.01	Electricity consumption	Kwh					5
04.52.01	Bottled butane gas	Kg					2
04.53.11	Fuel for illumination	Liter					3
04.54.00	**Solid fuel**						
04.54.01	Firewood	mt					
04.54.02	Charcoal	mt					2
04.54.03	Coal (for domestic consumption)	Kg					2

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Reference number | | | | | | | | |

MONTHLY EXPENSES

In the last 30 days did you buy or pay for (read listed goods and services one by one)?
If so, indicate the amount purchased, price paid, and where bought.

Code	Type of goods or services	Unit of measure	Quant	Total price (In Mts)	Place of purchase Store.......... 1 Market.......... 2 Informal Market...... 3 Other (specify) 4	Cod	Unit code
1	2	3	4	5	6	7	8
05.00.00	**HOUSEHOLD ACCESSORIES, APPLIANCES, AND MAINTENANCE OF THE HOUSING**						
05.11.10	**Furniture (except complete sets)**						
05.11.12	Clothing dressers or presses	Unit					
05.11.13	Chairs (wood, plastic)	Unit					1
05.11.17	Table (wood, plastic	Unit					1
05.11.20	**Other types of furniture**						
05.11.21	Kitchen table with chairs	Unit					
05.11.22	Complete dining room furniture	Unit					
05.11.24	Complete set of sofas	Unit					
05.11.26	Cribs and other furniture for babies	Unit					
05.11.30	**Lighting fixtures**						
05.11.31	Table lamps	Unit					
05.11.32	Ceiling and wall lamps	Unit					
05.11.33	Floor lamps	Unit					
05.11.40	**Articles for decoration**						
05.11.42	Paintings, prints, posters, etc.	Unit					
05.12.00	**CARPETS AND OTHER FLOOR COVERINGS (D)**						
05.12.01	Rugs	m2					
05.12.02	Carpets	m2					
05.12.03	Area rugs	m2					
05.13.00	Repair of furniture and accessories and repaving	mt					
05.20.00	**Textile articles for domestic use**						
05.20.15	Pillows	Unit					1
05.20.11	Bedspreads and sheets	Unit					1
05.20.21	Tablecloths	Unit					1
05.20.18	Mattresses	Unit					1
05.20.12	Blankets	Unit					1
05.20.42	Bath towels	Unit					1
05.20.51	Curtains	Unit					1

Reference number | | | | | | | | |

MONTHLY EXPENSES

In the last 30 days did you buy or pay for (read listed goods and services one by one)?
If so, indicate the amount purchased, price paid, and where bought.

Code	Type of goods or services	Unit of measure	Quant	Total price (In Mts)	Place of purchase Store.......... 1 Market.......... 2 Informal Market.......... 3 Other (specify) 4	Cod	Unit code
1	2	3	4	5	6	7	8
05.31.20	**Dryers and washing machines (except dishwashers)**						
05.31.25	Dishwasher	Unit					1
05.31.30	**Ovens (except gas or electric ovens)**						
05.31.31	Charcoal or wood stoves	Unit					1
05.31.38	Microwaves	Unit					1
05.31.35	Petroleum ovens	Unit					
05.31.40	Heaters, ventilators, etc. (excl.fans and air conditioners)						
05.31.50	**Vacuums, waxers, etc.**						
05.31.51	Vacuums	Unit					1
05.31.52	Cleaning machines	Unit					
05.31.70	**Other major domestic appliances**						
05.31.71	Other large domestic appliances (incl. safes)	mt					
05.31.72	Other large non-electric domestic appliances (incl. safes)	mt					
05.32.00	**SMALL ELECTRIC DOMESTIC APPLIANCES (SD)**						
05.32.01	Mixers	Unit					
05.32.02	Electric coffee pots and teapots	Unit					
05.33.00	Repair of domestic appliances	mt					
05.40.00	**Glasses and crystal, china, and other domestic utensils**						
05.40.24	Glasses	Unit					1
05.40.22	Jars	Unit					1
05.40.31	Silverware	Unit					1
05.40.23	Plates	Unit					1
05.40.25	Tea servers	Unit					1
05.40.40	**Other non-electric kitchen articles**						
05.40.46	Pans	Unit					1
05.40.41	Cooking scale	Unit					1
05.40.45	Plastic ware	Unit					

Reference number | | | | | | | | |

MONTHLY EXPENSES

In the last 30 days did you buy or pay for (read listed goods and services one by one)?
If so, indicate the amount purchased, price paid, and where bought.

Code	Type of goods or services	Unit of measure	Quant	Total price (In Mts)	Place of purchase: Store....... 1, Market....... 2, Informal Market....... 3, Other (specify) 4	Cod	Unit code
1	2	3	4	5	6	7	8
05.40.50	Repair of glassware, china, and kitchen utensils	mt					
05.51.00	Tools and shop equipment (including saws and electric drills)	mt					
05.52.00	**Small tools and various accessories (including hammers)**						
05.52.06	Lamps, lanterns, switches, plates, cables, receptacles, electric batteries, and other electrical devices.	Unit					
05.61.10	**Cleaning and maintenance products**						
05.61.12	Liquid detergent for washing dishes	l					
05.61.19	Powdered cleanser	kg					2
05.61.16	Soap	Unit					
05.61.17	Disinfectants, insecticides, and air fresheners, (including *baygon*)	Unit					
05.61.20	Other domestic consumables						
05.61.25	Matches	Box					9
05.61.23	Brushes and brooms	Unit					1
05.61.28	Candles	Unit					
05.62.10	Domestic services (including household employees)	mt					
05.62.20	Housing maintenance services (including extermination….)	mt					
06.00.00	**HEALTH**						
06.11.00	**MEDICINE AND VACCINES (ND)**						
06.11.01	Acetaminophen	mt					
06.11.02	Amoxicillin	mt					
06.11.03	Salferroso	mt					
06.11.04	Cotrimoxazole	mt					
06.11.05	Tetracycline	mt					
06.11.06	Mebendazole	mt					
06.11.07	Condom	mt					

Reference number | | | | | | | | |

MONTHLY EXPENSES

In the last 30 days did you buy or pay for (read listed goods and services one by one)?
If so, indicate the amount purchased, price paid, and where bought.

Code	Type of goods or services	Unit of measure	Quant	Total price (In Mts)	Place of purchase Store................................ Market.......................... Informal Market.............. Other (specify)	Cod 1 2 3 4	Unit code
1	2	3	4	5	6	7	8
06.11.08	Aminophylene	mt					
06.11.09	Mistura Oral (oral hydration salts)	mt					
06.11.11	Benzoic acid	mt					
06.11.12	Anti-asthma Salbutamol	mt					
06.11.13	Clorpheniramine	mt					
06.11.14	Aluminum hydroxide	mt					
06.11.15	Multivitamins	mt					
06.11.16	Anti-diarrhetics	mt					
06.11.17	Anti-malaria drugs	mt					
06.12.00	**OTHER PHARMACEUTICAL PRODUCTS (ND)**						
06.12.01	Oxygenated water, pure alcohol, iodine, and other antiseptics.	Liter					
06.12.03	Compresses, bandages (adhesive and non-adhesive), band-aids, and other wound dressings	Unit					
06.12.06	Condoms and other mechanical contraceptives	Package					
06.12.08	Thermometers	Unit					
06.12.09	Other pharmaceutical products and materials	Unit					
06.13.00	**THERAPEUTIC EQUIPMENT AND MATERIALS AND THEIR REPAIR (D)**						
06.13.02	Dental equipment and prosthesis	Unit					
06.13.03	Orthopedic equipment and prosthesis	Unit					
06.13.04	Orthopedic shoes	Unit					
06.13.06	Eyeglasses and contact lenses	Unit					
06.13.07	Wheelchairs (motorized or not) and traveling devices for invalids, artificial limbs and crutches	Unit					
06.13.08	Other therapeutic equipment and materials (medical massage equipment, treatment lamps, etc.)	Unit					
06.13.09	Repair of therapeutic equipment and materials	mt					
06.22.00	**DENTAL SERVICES (S)**						
06.22.01	Visits to private dentists' offices	mt					

Reference number | | | | | | | | |

MONTHLY EXPENSES

In the last 30 days did you buy or pay for (read listed goods and services one by one)?
If so, indicate the amount purchased, price paid, and where bought.

Code	Type of goods or services	Unit of measure	Quant	Total price (In Mts)	Place of purchase Store................. Market.......... Informal Market..... Other (specify)	Cod 1 2 3 4	Unit code
1	2	3	4	5	6	7	8
06.22.02	Dental visits in clinics or polyclinics	mt					
06.22.03	Dental visits in public services for ambulatory patients	mt					
06.22.04	Dental visits in other locations for ambulatory patients	mt					
06.23.10	**Laboratory tests**						
06.23.11	Tests in private laboratories	mt					
06.23.12	Tests in polyclinics	mt					
06.23.13	Tests in public services for ambulatory patients	mt					
06.23.30	**X-rays**						
06.23.31	X-rays in a private office	mt					
06.23.32	X-rays in clinics or polyclinics	mt					
06.23.33	X-rays in public services for ambulatory patients	mt					
06.23.50	**Nursing, physical therapy, and related services**						
06.23.51	Nursing services	mt					
06.23.52	Physical therapy services	mt					
06.23.53	Midwife services/ deliveries	mt					
06.23.58	Other services (products) from traditional doctors	mt					
06.30.10	**Basic services**						
06.30.11	Inpatient public hospital services	mt					
06.30.12	Inpatient services in private hospitals.	mt					
06.30.13	Other basic services in public hospitals	mt					
06.30.14	Other basic services in private hospitals	mt					
07.00.00	**TRANSPORTATION (without purchase of cars, motorcycles, and bicycles)**						
07.12.00	**MOTORCYCLES (D)**						
07.12.03	Other motorcycles	Unit					
07.14.00	Animal-drawn vehicles	Unit					
07.21.00	**Parts and accessories for personal transportation vehicles**						
07.21.06	Tires	Unit					1
07.21.03	Inner tubes	Unit					1
07.21.02	Batteries	Unit					1
07.21.08	Spark plugs	Unit					1
07.21.04	Filters	Unit					1

Reference number | | | | | | | | |

MONTHLY EXPENSES

In the last 30 days did you buy or pay for (read listed goods and services one by one)?
If so, indicate the amount purchased, price paid, and where bought.

Code	Type of goods or services	Unit of measure	Quant	Total price (In Mts)	Place of purchase Store.................. 1 Market.......... 2 Informal Market........ 3 Other (specify) 4	Cod	Unit code
1	2	3	4	5	6	7	8
07.21.05	Parts for the engine	Unit					1
07.22.00	**Fuels and lubricants**						
07.22.01	Gasoline	Liter					3
07.22.02	Diesel	Liter					3
07.22.06	Oil for personal transportation vehicles	Liter					
07.23.00	**Maintenance and repair of personal transportation vehicles**						
07.23.02	Washing and lubrication of personal transportation vehicles	mt					
07.23.03	Oil changes for personal transportation vehicles	mt					
07.23.05	Body repair and painting	mt					
07.24.00	**Other services related to personal transportation vehicles**						
07.24.02	Lessons, tests, and driving licenses	mt					
07.24.04	Parking meters and tolls	mt					
07.30.00	**TRANSPORTATION SERVICES**						
07.31.00	Rail passenger transportation	mt					
07.32.00	**Highway passenger transportation**						
07.32.02	Long-distance rides	mt					
07.32.05	Taxi transportation	mt					
07.33.00	**Air passenger transportation**						
07.33.01	Domestic air transportation (within the country)	mt					
07.33.02	Medium distance air transportation (Regional airlines, SADC, ...)	mt					
07.33.03	Long-distance air transportation	mt					
07.34.00	**PASSENGER TRANSPORTATION BY SEA AND NAVIGABLE RIVERS (S)**						
07.34.01	Transportation by passenger ships, ferry boats, etc.	mt					
07.34.02	Other passenger transportation services by sea and navigable rivers	mt					
07.36.00	Other transport services (including travel agents)	mt					
08.00.00	**COMMUNICATIONS (without purchasing fixed phones or cellular phones)**						
08.10.00	Postal services (stamps)	mt					

Reference number | | | | | | | | |

MONTHLY EXPENSES

In the last 30 days did you buy or pay for (read listed goods and services one by one)?
If so, indicate the amount purchased, price paid, and where bought.

Code	Type of goods or services	Unit of measure	Quant	Total price (In Mts)	Place of purchase Store........ 1 Market........ 2 Informal Market........ 3 Other (specify) 4	Cod	Unit code
1	2	3	4	5	6	7	8
08.20.00	**TELECOMMUNICATIONS EQUIPMENT AND ITS REPAIR (D)**						
08.20.03	Repair of fixed network equipment	mt					
08.20.06	Repair of mobile network equipment	mt					
08.30.10	**Fixed network communications**						
08.30.12	Fixed network communications	mt					
08.30.16	Internet connection or data transmission services	mt					
08.30.17	Calls from telephone offices or public booths	mt					
08.30.20	**Mobile network communications**						
08.30.21	Monthly mobile telephone bill	mt					
08.30.23	Other mobile network communications services	mt					
09.00.00	**LEISURE AND CULTURE**						
09.11.10	**Equipment for reception and reproduction of sound (excluding radios and stereos)**						
09.11.15	Audio tape recorders/players	Unit					
09.11.16	CD players	Unit					
09.11.20	**Equipment for television, videorecorders, etc. (excluding television sets)**						
09.11.22	Video recorders/players	Unit					
09.11.23	DVD recorders/players	Unit					
09.11.24	Television antennas	Unit					
09.12.10	**Photographic and cinematographic equipment**						
09.12.11	Video cameras	Unit					1
09.12.12	Movie cameras	Unit					1
09.12.13	Still cameras	Unit					1
09.12.20	**Optical instruments**						
09.12.21	Binoculars	Unit					1
09.12.25	Other optical instruments	Unit					
09.13.00	**Data processing equipment (excluding computer and printer)**						
09.13.01	Calculators, including pocket ones	Unit					1
09.13.08	Software, except for computer games, consoles, etc.	Unit					

Reference number | | | | | | | | |

MONTHLY EXPENSES

In the last 30 days did you buy or pay for (read listed goods and services one by one)?
If so, indicate the amount purchased, price paid, and where bought.

Code	Type of goods or services	Unit of measure	Quant	Total price (In Mts)	Place of purchase Store Market Informal Market Other (specify)	Cod 1 2 3 4	Unit code
1	2	3	4	5	6	7	8
09.14.00	**Material for recording sound and images**						
09.14.01	Audio cassettes, including recorded ones	Unit					1
09.14.02	Video cassettes, including recording ones	Unit					1
09.14.03	Audio CD, recorded	Unit					1
09.14.04	Blank CDs (CD-R or CD-RW)	Unit					
09.14.06	Floppy disks or flash drives	Unit					
09.15.00	Repair of AV, photo, data-processing eqpt.	mt					
09.21.10	**Durable goods for outdoor leisure**						
09.21.03	Pleasure boats	Unit					1
09.22.10	**Musical instruments**						
09.22.11	Guitars and violas	Unit					1
09.22.12	Organs	Unit					1
09.22.20	**Durable goods for indoor leisure**						
09.22.21	Tables for billiards, snooker, ping pong, etc.	Unit					1
09.22.22	Other durable goods for indoor recreation and leisure activities	Unit					1
09.23.00	Maintenance and repair of other durable goods for recreation and culture	mt					
09.31.00	**Games, toys, articles for pastimes**						
09.31.10	**Games**						
09.31.12	Playing cards, chess, scrabble, etc.	Unit					1
09.31.16	Other games	Unit					
09.31.20	**Toys and articles for pastimes**						
09.31.21	Toy bicycles and tricycles	Unit					
09.31.22	Puppets, marionettes, and stuffed toys	Unit					
09.32.00	**PURCHASE & REP.OF EQUPT FOR SPORTS, CAMPING, AND OUTDOOR RECREATION (SD)**						
09.32.01	Sports balls	Unit					1
09.32.04	Fishing equipment	Unit					1
09.33.00	Plants and natural or artificial flowers and other products for the garden	mt					

Reference number | | | | | | | | |

MONTHLY EXPENSES

In the last 30 days did you buy or pay for (read listed goods and services one by one)?
If so, indicate the amount purchased, price paid, and where bought.

Code	Type of goods or services	Unit of measure	Quant	Total price (In Mts)	Place of purchase Store................ 1 Market.......... 2 Informal Market....... 3 Other (specify) 4	Cod	Unit code
1	2	3	4	5	6	7	8
09.34.00	Pets and related products						
09.34.01	Pets	Unit					
09.34.02	Pet food	Unit					
09.35.00	Veterinary and other services for pets	mt					
09.41.00	**SPORT AND RECREATION SERVICES (S)**						
09.41.03	Swimming pool entrance fees	mt					
09.41.04	Tickets to football games	mt					
09.41.06	Tickets to fairs and amusement parks	mt					
09.42.10	**Cinemas, theaters, and concerts**						
09.42.11	Movie tickets	mt					
09.42.12	Theater tickets	mt					
09.42.20	**Museums, botanical gardens, zoos, etc.**						
09.42.22	Entrance to museums and historical monuments	mt					
09.42.30	**Radio and television fees and equipment rental**						
09.42.31	Television fees	mt					
09.42.32	Radio fees	mt					
09.42.33	Video rentals	mt					
09.42.40	**Other cultural services (including photographic services)**						
09.42.42	Photo services (portraits, developing, printing, etc.)	mt					
09.43.00	**Games of chance**						
09.43.01	Lottery	Unit					
09.43.02	*Totoloto/ totobola*	Unit					
09.43.03	Other gambling services	mt					
09.51.00	**Books (excluding school texts)**						
09.51.02	Technical books (atlases, dictionaries, encyclopedias, manuals, etc.)	Unit					
09.51.04	Literary books (novels, etc.)	Unit					

Reference number | | | | | | | | |

MONTHLY EXPENSES

In the last 30 days did you buy or pay for (read listed goods and services one by one)?
If so, indicate the amount purchased, price paid, and where bought.

Code	Type of goods or services	Unit of measure	Quant	Total price (In Mts)	Place of purchase Store.......... 1 Market.......... 2 Informal Market.......... 3 Other (specify) 4	Cod	Unit code
1	2	3	4	5	6	7	8
09.52.00	**NEWSPAPERS AND MAGAZINES (ND)**						
09.52.01	Daily newspapers	Unit					
09.52.02	Weekly newspapers	Unit					
09.52.07	Magazines	Unit					
09.53.00	**MISCELLANEOUS PRINTED MATERIAL (ND)**						
09.53.02	Calendars	Unit					
09.54.00	**Stationery and drawing articles**						
09.54.01	Agendas and notepads	Unit					
09.54.02	Notebooks and school pads	Unit					
09.54.04	Ball point pens, pencils, erasers, pens, etc.	Unit					
09.54.07	Rulers, squares, protractors, compasses, etc.	Unit					
09.60.00	Organized trips (including vacations)	mt					
10.00.00	**EDUCATION (formal education expenses are in the questionnaire for the family household)**						
10.50.02	Language courses	mt					
10.50.03	Professional training courses	mt					
11.00.00	**HOTELS (Expenses in restaurants, bars, taverns are covered in the Daily Expenses Questionnaire)**						
11.20.00	**Lodging services (including hotels, inns, boarding houses)**						
11.20.01	Bed and breakfast in hotels, residences, boarding houses, etc.	Unit					
12.00.00	**MISCELLANEOUS GOODS AND SERVICES**						
12.11.00	**Barber shops and beauty salons**						
12.11.01	Shaves	mt					
12.11.02	Men's haircuts	mt					
12.11.06	Dying, straightening, washing, curling, braiding, and other service by women's hairdressers	mt					

Reference number | | | | | | | | |

MONTHLY EXPENSES

In the last 30 days did you buy or pay for (read listed goods and services one by one)?
If so, indicate the amount purchased, price paid, and where bought.

Code	Type of goods or services	Unit of measure	Quant	Total price (In Mts)	Place of purchase Store........................ Market........................ Informal Market.......... Other (specify)	Cod 1 2 3 4	Unit code
1	2	3	4	5	6	7	8
12.12.00	**Personal care electrical appliances**						
12.12.01	Electric hair cutters	Unit					1
12.12.04	Hair dryers	Unit					1
12.12.07	Repair services for personal care electrical appliances	Unit					
12.13.10	**Non-electrical appliances for personal care**						
12.13.12	Non-electric hairbrushes and combs	Unit					1
12.13.14	Rollers and hairbands for the hair	Unit					1
12.13.16	Non-electric toothbrushes	Unit					1
12.13.20	**Perfumes, cosmetics, and hygiene products**						
12.13.21	Aftershave and balms for the beard	Unit					7
12.13.22	Perfumes and colognes	Unit					
12.13.23	Lipstick and rouge	Unit					
12.13.24	Shampoos	Unit					
12.13.25	Hair mousse and gel, beauty creams and oils, and shaving cream	Unit					
12.13.26	Deodorants and makeup	Unit					
12.13.28	Toothpaste	Unit					
12.13.30	**Other personal care products**						
12.13.31	Soap bars	Unit					
12.13.32	Disposable diapers	Unit					
12.13.33	Paper napkins, towels, and towlettes	Unit					
12.13.36	Toilet paper	Unit					
12.13.37	Sanitary pads and tampons	Unit					
12.31.00	**JEWELRY, TRINKETS, AND WATCHES AND THEIR REPAIRS** (D)						
12.31.01	Jewels and gemstones	Unit					
12.31.03	Wall clocks, wrist watches, pocket watches	Unit					
12.31.07	Repair of jewelry, trinkets, and watches	mt					

MONTHLY EXPENSES

Reference number | | | | | | | | |

In the last 30 days did you buy or pay for (read listed goods and services one by one)?
If so, indicate the amount purchased, price paid, and where bought.

Code	Type of goods or services	Unit of measure	Quant	Total price **(In Mts)**	Place of purchase Store.................. 1 Market.................. 2 Informal Market........ 3 Other (specify) 4	Cod	Unit code
1	2	3	4	5	6	7	8
12.32.10	**Suitcases, purses, and similar articles for personal use and their repair**						
12.32.11	Purses, wallets, and billfolds	Unit					
12.32.12	Suitcases, knapsacks, and duffel bags for travel	Unit					
12.32.14	Other travel articles for personal use and their repair	Unit					
12.32.20	**Personal use items for smokers**						
12.32.23	Lighters	Unit					
12.32.24	Ashtrays	Unit					
12.32.25	Other personal use items for smokers and their repair	Unit					
12.32.30	**Personal use items for babies and their repair**						
12.32.31	Baskets and cradles for babies	Unit					
12.32.40	**Other personal use items and their repair**						
12.32.41	Personal calendars	Unit					
12.32.42	Sunglasses	Unit					
12.32.43	Umbrellas, parasols, and canes	Unit					
12.32.44	Urns, caskets, tombstones, etc.	Unit					
12.40.10	**Social protection services (including homes for the elderly)**						
12.40.11	Private homes (for the elderly, handicapped, ill, students, etc.)	mt					
12.40.12	Public homes (for the elderly, handicapped, ill, students, etc.)	mt					
12.40.13	Other homes (for the elderly, handicapped, ill, students, etc.)	mt					
12.40.14	At-home services (for the elderly, handicapped, ill, students, etc.)	mt					
12.40.15	Other social protection services, (elderly and handicapped day care centers, etc.)	mt					
12.40.20	**Child care centers and nurseries**						
12.40.21	Private child care centers and nurseries	mt					
12.40.22	Public child care centers and nurseries	mt					
12.50.00	**INSURANCE**						
12.51.00	Life insurance	mt					
12.52.00	Housing related insurance	mt					
12.53.00	Health related insurance	mt					

Reference number | | | | | | | | |

MONTHLY EXPENSES

In the last 30 days did you buy or pay for (read listed goods and services one by one)?
If so, indicate the amount purchased, price paid, and where bought.

Code	Type of goods or services	Unit of measure	Quant	Total price **(In Mts)**	Place of purchase Store.......................... Market......................... Informal Market........... Other (specify)	Cod 1 2 3 4	Unit code
1	2	3	4	5	6	7	8
12.54.00	Transportation related insurance	mt					
12.55.00	Other insurance	mt					
12.70.00	**OTHER SERVICES, NOT SPECIFIED**						
12.70.01	Dues for professional associations	mt					
12.70.02	Dues for sports associations	mt					
12.70.03	Dues for other associations (not sports or professional associations)	mt					
12.70.04	Issuance and copying of documents (identity cards, certificates, passports, etc.)	mt					
12.70.05	Newspaper ads	mt					
12.70.06	Funeral and similar services	mt					
12.70.07	Legal services (property registration, notarization, lawyers' fees, etc.)	mt					
12.70.08	Photocopies	mt					
12.70.09	Miscellaneous other personal services	mt					

Reference Number

INCOME

(In Meticais)

	Pessoa Nº	Pessoa Nº	Pessoa Nº
Enter the member number and name of each person who in the household who paid or received one of the transfers mentioned below (The member number should correspond to the list of members.)	--------------------	------------------	-------------------

TRANSFERS

TRANSFERS PAID IN THE LAST MONTH

1. How much was paid for alimony?			
2. How much was paid for board pension?			
3. How much was paid for interest (incl. Leasing payments)?			
4. How much was transferred abroad?			
5. How much was paid to clubs, parties, associations?			
6. How much was contributed to nonprofit and religious institutions?			
7. How much was paid to rotating savings and loan associations?			
8. Other transfers?			
TRANSFERS RECEIVED IN THE LAST MONTH			
1. How much was received for reform pension?			
2. How much was received for alimony?			
3. How much was received for survivor's pension?			
4. How much was received for board pension?			
5. How much was received in interest from banks or borrowers?			
6. How much was received from insurance?			
7. How much money was given to you by nonprofit or religious institutions?			
8. What is the estimated value of in-kind items received from these organizations (on line 7)?			
9. How much was received from family members living outside the household?			
10. What is the estimated value of in-kind items received from these family members?			
11. How much was received from family members working abroad?			
12. What is the estimated value of in-kind items received from these family members (on line 11)?			
13. How much was received from the rotating savings and loan association?			
14. Other transfers received			

Reference number | | | | | | | |

INCOME IN THE LAST MONTH

(In Meticais)

ENTER THE MEMBER NUMBER AND NAME OF EACH PERSON IN THE HOUSEHOLD WHO RECEIVED ANY TYPE OF INCOME (THE MEMBER NUMBER SHOULD CORRESPOND TO THE ONE IN THE LIST OF MEMBERS)	Person Nº	Person Nº	Person Nº	Person Nº	Person Nº
1. WHAT WAS THE NET INCOME FROM:					
1. Rental of the house					
2. Rental of farmland					
3. Car rental					
2. SPECIAL INCOME					
1. Gambling (Lottery, *totabola* , raffles etc.)					
2. Bequests					
3. Other occasional income					

Reference number

TRANSFERS FROM CHILDREN OR SPOUSE OF THE HEAD OF HOUSEHOLD
WHO ARE NOT MEMBERS OF THE FAMILY HOUSEHOLD

												RECEITAS				PROGRAMAS DO INAS	
LINE NUMBER	(1)	(2)	(3)	(4)	5		(6)		(7)	(8)		(9)	(10)		(11)		
	List all children of head of household at least 15 years old not living in the household (include partner of head of household not living in the household)	Age	Sex Male Female	Relation to head of household 1 2 Child	What was the highest education level (NAME) attended? What was the highest grade that (NAME) finished?		Where does [NAME] live now? If in Mozambique enter Province; if not, enter the country		In what year did (NAME) go to live for the first time in (COUNTRY)	What is the primary occupation of (NAME)?		Did (NAME) send money or products to this family household in the last 12 months? YES 1 NO 2 >>11	What is the total value of the transfers that (NAME) made in the last 12 months?		How does (NAME) send these transfers?	Did this family household receive some support from the basic food subsidy program (PSA) in the last 12 months? YES .... NO 2	Did this family household receive some material support from the direct social support program (PASD) in the last 12 months? YES NO
		YEARS			LEVEL	GRADE	PROV./COUNT.	CODE	YEAR	OCCUPATION	CODE		CURRENCY	VALUE			
01																	
02																	
03																	
04																	
05																	
06																	

1. BANK TRANSFER
2. TRANSFER BY THE COMPANY
3. BRINGS MONEY WHEN COMING
4. OTHER

Reference number | | | | | | | | |

FAMILY HOUSEHOLD SMALL BUSINESSES

[ASK THE QUESTION TO THE HEAD OF HOUSEHOLD THEN INTERVIEW MANAGER OF THE BUSINESS]

1. In the last 12 months, did any member of this family household engage in some activity that generated income not from farming or livestock raising? **YES .... 1 NO....... 2**

NO. BUSINESS	1A. What type of business of members of this family household generated income in the last 12 months? LIST ALL BUSINESSES FIRST AND THEN ASK THE QUESTIONS		Who in this household runs the business? IF MORE THAN ONE PROPRIETOR, LIST THEM.		How many months during the last 12 months was this business operational?	Where is this business located? AT HOME .... 1 INDUSTRIAL ZONE .... 2 MARKET .... 3 COMMERCIAL ZONE .... 4 STREET .... 5 ELSEWHERE _______ 6	How many months ago did this business start operations?
	DESCRIPTION OF THE BUSINESS	COD.	(a) ORDER Nº	(b) ORDER Nº	NUMBER OF MONTHS		MONTHS
			(2)		(3)	(4)	(5)
1							
2							
3							
4							
5							
6							
7							

NO. BUSINESS	6. Which members of this family household are engaged in this business besides the proprietor named in question 2? ENTER CODE OF THE HOUSEHOLD MEMBER FROM THE MEMBER LIST. ORDER Nº				What was the average monthly income from the business in the last 12 months?	During the last 12 months, how many employees worked who are not members of the family household?	What was the average monthly expense for salaries in the last 12 months?	What was the average monthly expense for materials in the last 12 months?	Other average monthly operating expense for fuel, electricity, water, etc. in last 12 months?
	(a)	(b)	(c)	(d)	(In Mts)	NUMBER OF EMPLOYEES	(In Mts)	(In Mts)	(In Mts)
	(6)				(7)	(8)	(9)	(10)	(11)
1									
2									
3									

SURVEY ON FOOD SECURITY AND NUTRITION ASSESSMENT OF THE IMPACTS OF HIGH FOOD PRICE IN BANGLADESH 2008

HOUSEHOLD QUESTIONNAIRE

World Food Programme
IDB Bhaban (17th floor), Rokeya Sarani
Dhaka 1207, Bangladesh
and

UNICEF

and

MITRA AND ASSOCIATES
(Centre for Research and Consultancy)
2/17 Iqbal Road, Mohammadpur, Dhaka-1207, Bangladesh
Tel: 880-2-8118065/9115503, Email: mitra@citech.net, Fax: 880-2-9126806

1

<table>
<tr><td colspan="3">District:</td><td colspan="4">Upazila:</td><td>Union/Thana:</td></tr>
<tr><td colspan="3">Village/Para:</td><td colspan="5">Urban thana/Municipality/SMA</td></tr>
<tr><td colspan="2">Urban area, Ward #</td><td colspan="4">PSU/Cluster #</td><td colspan="2">Household Questionnaire Id.</td></tr>
<tr><td colspan="8">In urban areas House #, Street #, Locality name:</td></tr>
<tr><td colspan="4">Name of the Head of household:</td><td colspan="4" rowspan="2">Name of enumerator 1:</td></tr>
<tr><td colspan="4">Name of main respondent (Head of household or in case head is absent a knowledgeable person in the household):</td></tr>
<tr><td colspan="4">Name of respondent for Section 12 (Head of Household or in case he/she is not knowledgeable, the person assisting her/he):</td><td colspan="4">Name of enumerator 2:</td></tr>
<tr><td>Date: dd/mm/yyyy</td><td colspan="4">Name of supervisor :</td><td colspan="3">Signature of the Supervisor after check:</td></tr>
</table>

1. HOUSEHOLD COMPOSITION/DEMOGRAPHICS

ID	Name of the members	Age Write in full years **(write "00" if age is below 1year)**	Sex **Male=1 Female=2**	Relationship with household **Code 1**	Marital status **Code 2**	Highest class completed? **Write down the class number 99 if never attended**	Any married woman in the household that is pregnant or lactating? **Code 3**	Any members physically disabled in any way in the household?/ Is (NAME) physically disabled? **0 = No 1 = Yes If No, go to Next line**	What physical disability is it? **Please write down the disability**	For this disability, is he able to work? **0 = No 1 = Yes**
1.1.	1.2.	1.3.	1.4.	1.5.	1.6.	1.7.	1.8.	1.9.	1.10.	1.11.
01.										
02.										
03.										
04.										
05.										
06.										
07.										
08.										
09.										
10										
11										
12										
13										
14										
15										

Code 1	Code- 2	Code 3
1 = Household head **2** = Husband/wife **3** = Son/daughter **4** = Brother/sister **5** = Father/mother **6** = Father-in-law/mother-in-law **7** = Son-in-law/daughter-in-law **8** = Brother-in-law/sister-in-law **9** = Grand child **10** = Nephew/niece **11** = Other relative **12** = Other Non-relative	**1**= Married **2**= Widowed **3** = Separated/Divorced **4**= Never married	**0** = No **1** = Pregnant **2** = Lactating **3** = Pregnant and lactating 4 = Not applicable

2. HOUSING, WATER,ENERGY

2.1.	What is the main construction material of the walls of the main dwelling house? (watch and list)	|___|	Brick/cement = 1 Tin/C.I. Sheet//Wood = 2 Mud brick for wall = 3 Brick of tally = 4 Hemp/hay/bamboo = 5 Other= 6______________
2.2.	What is the main construction material of the roof of the main dwelling house? (watch and list)	|___|	Brick/cement = 1 Tin/C.I. Sheet//Wood = 2 Mud brick for wall = 3 Brick of tally = 4 Hemp/hay/bamboo = 5 Other = 6______________
2.3.	What is your present occupancy status?	|___|	Own = 1 Rent = 2 → **Go to 2.5** Other= 3_________________
2.4.	What would be the monthly rent if you rented a house like this?	|___|	Taka → **Go to 2.10** Don't know = 99999 → **Go to 2.10**
2.5.	If you are renting, what is the monthly rent?	|___|	Taka ☐☐☐☐☐
2.6.	Has the monthly rent over 12 months increased?	|___|	0 = No 1 = Yes
2.7.	If yes by how much per month?	|_______|	Taka ☐☐☐☐
2.8.	Are you **currently in debt for your rent** payment?	|___|	**0**= No→ ***If No, go to 2.10*** **1**= Yes
2.9.	Has your **debt for rent increased** over the **past 12 months**	|____|	**0**= No **1**= Yes
2.10.	Does the household have an electricity connection?	|____|	Yes, National Grid =1 Yes, Solar electricity owned =2 Yes, Solar electricity rented/instalment =3 No =4 →**If No, go to 2.15**
2.11.	What was the amount of the last electricity bill (Tk.) that you have paid (write "0" if no connection)	|______| **Taka**	Taka ☐☐☐☐☐ Electricity bill attached with house rent/illegal connection=99999 **(if "0" or "99999" skip to 2.15)**
2.12.	For how many months was the electricity bill for?	|____|	Months = ☐☐ 99 = If don't know
2.13.	Has the cost of electricity increased over the last 12 months?	|__|	**0**= No **1**= Yes
2.14.	If yes, by how much per month?	|______|	Taka ☐☐☐☐
2.15.	Has your household faced difficulties in paying the utility bills (like electricity, gas, etc.)?	|__|	**0**= No **1**= Yes **2** = Not applicable

WATSAN *(don't read the codes, let the respondent answer)*	At the moment		12 months ago	
What is the main source of **drinking water** for members of your household? **PIPED WATER** 01= PIPED INTO DWELLING 02= PIPED TO YARD/PLOT 03= PUBLIC TAP/STANDPIPE 04= TUBEWELL OR BOREHOLE **DUG WELL** 05= PROTECTED WELL 06= UNPROTECTED WELL **WATER FROM SPRING** 07= PROTECTED SPRING 08= UNPROTECTED SPRING 09= RAIN WATER 10= TANKER TRUCK 11= CART WITH SMALL TANK 12= SURFACE WATER (RIVER/DAM/LAKE/PONDS/STREAM/CANAL/IRRIGATION CHANNEL 96= OTHER (SPECIFY)___________	2.16.	|__|	2.17.	|__|
Do you treat your water in any way to make it safer for drinking? 0 = No, 1= Yes	2.18.	|__|	2.19.	|__|
If yes, what you usually do to treat the drinking water? **1=** boil, **2=** bleach, **3=** strain through cloth, **4=** filter water (ceramic sand etc.), **5=** solar disinfection, **6=** let it stand still, **7=** purifying tabs, **8=** other (specify)____________________________ ; **9=** do not know	2.20.	|__|	2.21.	|__|
What kind of **toilet facility** does your household use? **FLUSH OR POUR FLUSH TOILET** 01= FLUSH TO PIPED SEWER SYSTEM 02= FLUSH TO SEPTIC TANK 03= FLUSH TO PIT LATRINE 04= FLUSH TO SOMEWHERE ELSE 05= FLUSH, DON'T KNOW WHERE **PIT LATRINE** 06= PIT LATRINE WITH SLAB 07= PIT LATRINE WITHOUT SLAB/OPEN PIT 08= BUCKET TOILET 09= HANGING TOILET/HANGING LATRINE 10= NO FACILITY/BUSH/FIELD 96= OTHER (SPECIFY)___________	2.22.	|__|	2.23.	|__|
If using latrine, how many households share the latrine? 1= One household 2= Two to four households 3= Five or more households	2.24.	|__|	2.25.	|__|

3. LIVELIHOODS, INCOME & WAGES

	Currently		A year ago	
How many household members earn an income?	3.1.	|____|	3.2.	|____|
How many different sources of income do you have to sustain your household (family)? *(All income sources of the household) Please refer to the codes below*	3.3.	|____|	3.4.	|____|
How much does your household earn per month? *(Average monthly income of the household)*	3.5.	|_________| Taka	3.6.	|_________| Taka
What is your household's **most important source of livelihoods?** **What comes second**? *Please refer to the codes below*	Most important source		Second source	
1= Own Farming, **2=** Lease farming, **3=** Share cropping, **4=** Livestock/dairy/Poultry farming/rearing, **5=** Fishing, **6=** Fisheries, **7=** Agricultural wage labour (employed for farm work), **8=** Non-agricultural wage labour (ex: store work, restaurant waiters, domestic worker, construction worker, transport worker, rickshaw puller etc.) **9=** Self-employed (taxi, carpenter, rickshaw/van/boat owner etc) **10=** Low salaried employee (clerk, peon, primary school teacher, non commissioned services in government etc) **11=** NGO or Government employee salaried (BCS/commissioned/officer) **12=** Professional/technical **13=** Industrial worker (garments & other industries) **14=** Petty trade (small scale) **15=** Business (large scale) **16=** Pension **17** = irregular daily labour, casual worker **18** = Remittances (in country) **19** = Remittances (foreign) **20** = Other (specify) ______	3.7.	|__|	3.8.	|__|

99 = No 2nd source of income				
Is the first source of income **temporary/casual, seasonal or stable?** **1**= Temporary/casual **2**= Seasonal **3**= Stable	3.9.	|___|		
Is the second source of income **temporary/casual, seasonal or stable?** **1**= Temporary/casual **2**= Seasonal **3**= Stable			3.10	|___|

3.11.	Has the **income of your household changed in the past 12 months**? **1**= No change / **2**= Decreased / **3**= Increased		|__| ***If No change, go to 3.13***
3.12.	**By how much** has it changed (either decreased or increased) per month?		|_______| Taka
3.13.	Have you **received any support in the past 12 months, in cash or food or both**?	**0**= No **1**= Yes	|__|
3.14.	Yourself, **are you supporting relatives with food or cash or both, at the moment**?	**0**= No **1**= Yes	|__|

3.15.	Do you have any household members who have **migrated within country**?	**0**= No **1**= Yes	|__|
3.16.	Do you have any household members who have **migrated abroad (outside country)**?	**0**= No **1**= Yes	|__| ***If No in Q3.15 and Q3.16, than go to 3.24***

	Migrant No.1		Migrant No.2		Migrant No.3	
Since when have they left? **1**= less than 1 month **2**= less than 6 months ago **3**= between 6 and 12 months ago **4**= More than 1 year ago **99**= No 2nd migrant, or no 3rd migrant	3.17.	|__|	3.18.	|__|	3.19	|__|
Why have they left? **1**= to work **2**= studies **3**= health treatment **4**= family reunion **99**= No 2nd migrant, or no 3rd migrant	3.20.	|__|	3.21.	|__|	3.22	|__|

3.23.	Do any of the migrants **send money back, during the last 12 months**?	**0**= No **1**= Yes	|__|

3.24. Did any of your household members engage in agriculture wage labour or daily labour? **No=0 Yes =1** |___|

3.25. **If yes, fill up this table for the main wage income earner:**

Name: ______________________________ **ID#** ☐☐ **Description of work:** ____________________________

Name: ______________________________ **ID#** ☐☐ **Description of work:** ____________________________

Name of season		Daily wage rate (Taka)		Number of days worked in a month		Total income per month	
	3.26.	3.27.		3.28.		3.29.	
	0= No **1**= Yes	Male	Female	Male	Female	Male	Female
Lean season (March-April) 2007	|__|						
Harvest Boro (May-June) 2007	|__|						
Harvest Aman (end Nov-Dec) 2007	|__|						
Lean (March –April), 2008	|__|						
Harvest (May-June) 2008	|__|						

3.30. Did any of your household members engage in non-agriculture wage labour or day labour? **No=0 Yes=1**|__|

3.31. If yes, fill up this table for the main wage income earner:

Name: ______________________________ **ID#** ☐☐ **Description of work:** ____________________________

Name: ______________________________ **ID#** ☐☐ **Description of work:** ____________________________

Name of season		Daily wage rate (Taka)		Number of days worked in a month		Total income per month	
	3.32.	3.33.		3.34.		3.35.	
	0= No/**1**= Yes	Male	Female	Male	Female	Male	Female
Lean season (March-April) 2007	|__|						
Harvest Boro (May-June) 2007	|__|						

Harvest Aman (end Nov-Dec) 2007	|__|						
Lean (March –April), 2008	|__|						
Harvest (May-June) 2008	|__|						

3.36. Did any of your household members engage in salaried employment (service)? **No=0 Yes =1** |___|

3.37. If yes, fill up this table for main salaried income earner:

Name:______________________________________ **ID#** ☐☐ **Description of work:**__________________________________

Name:______________________________________ **ID#** ☐☐ **Description of work:**__________________________________

Name of season		Total salary for the month	
	3.38.	3.39.	
	0= No / **1**= Yes	Male	Female
Jan-Feb 2007	|__|		
June-July 2007	|__|		
Nov-December 2007	|__|		
Jan-Feb, 2008	|__|		
June-July 2008	|__|		

4. **AGRICULTURE AND FOOD SELF-SUFFICIENCY**

Do you usually cultivate	A home garden?	**0**= No **1**= Yes	4.1.	___
	Other land/field?	**0**= No **1**= Yes	4.2.	___

If NO for both 4.1 and 4.2, go to Section 5

Code #	*Each product below is the main produced on the area*	**How much acreage of these crops did you cultivate this year/season (2007/2008)?** -A-		**What proportion of the crop (harvest or area) has been damaged or lost?** (%) *Leave blank (do NOT write 0) if the crop is not planted* -B-		How much of these products did you **SELL during this year/season (2007/2008)?** *Leave blank (do NOT write 0) if the crop is not planted* -C-				How much of these products did you **BUY for your family consumption during this year/season (2007/2008)?** *Leave blank (do NOT write 0) if the crop is not planted* -D-			
							Quantity	Price/unit (Taka)	Value (Taka)		Quantity	Price/unit (Taka)	Value (Taka)
01	Boro Paddy	4.3.	______ dm2	4.27.	____ %	4.51.	____ kg	____	______	4.75.	____ kg	____	______
02	Boro Rice	4.4.	______ dm2	4.28.	____ %	4.52.	____ kg	____	______	4.76.	____ kg	____	______
03	Aman Paddy	4.5.	______ dm2	4.29.	____ %	4.53.	____ kg	____	______	4.77.	____ kg	____	______
04	Aman Rice	4.6.	______ dm2	4.30.	____ %	4.54.	____ kg	____	______	4.78.	____ kg	____	______
05	Aus Paddy	4.7.	______ dm2	4.31.	____ %	4.55.	____ kg	____	______	4.79.	____ kg	____	______
06	Aus Rice	4.8.	______ dm2	4.32.	____ %	4.56.	____ kg	____	______	4.80.	____ kg	____	______
07	Wheat	4.9.	______ dm2	4.33.	____ %	4.57.	____ kg	____	______	4.81.	____ kg	____	______
08	Ata	4.10.	______ dm2	4.34.	____ %	4.58.	____ kg	____	______	4.82.	____ kg	____	______
09	Mustard/oil seeds	4.11.	______ dm2	4.35.	____ %	4.59.	____ kg	____	______	4.83.	____ kg	____	______
10	Potato	4.12.	______ dm2	4.36.	____ %	4.60.	____ kg	____	______	4.84.	____ kg	____	______
11	Veg (specify)……..	4.13.	______ dm2	4.37.	____ %	4.61.	____ kg	____	______	4.85.	____ kg	____	______
12	Veg (specify)……..	4.14.	______ dm2	4.38.	____ %	4.62.	____ kg	____	______	4.86.	____ kg	____	______
13	Veg (specify)……..	4.15.	______ dm2	4.39.	____ %	4.63.	____ kg	____	______	4.87.	____ kg	____	______
14	Veg (specify)……..	4.16.	______ dm2	4.40.	____ %	4.64.	____ kg	____	______	4.88.	____ kg	____	______

Code #	*Each product below is the main produced on the area*	**How much acreage of these crops did you cultivate this year/season (2007/2008)?** -A-		**What proportion of the crop (harvest or area) has been damaged or lost?** (%) *Leave blank (do NOT write 0) if the crop is not planted* -B-		How much of these products did you **SELL during this year/season (2007/2008)?** *Leave blank (do NOT write 0) if the crop is not planted* -C-				How much of these products did you **BUY for your family consumption during this year/season (2007/2008)?** *Leave blank (do NOT write 0) if the crop is not planted* -D-			
							Quantity	Price/unit (Taka)	Value (Taka)		Quantity	Price/unit (Taka)	Value (Taka)
15	Veg (specify)……..	4.17.	______ dm2	4.41.	____ %	4.65.	____ kg	____	______	4.89.	____ kg	____	______
16	Masur	4.18.	______ dm2	4.42.	____ %	4.66.	____ kg	____	______	4.90.	____ kg	____	______
17	Khesari	4.19.	______ dm2	4.43.	____ %	4.67.	____ kg	____	______	4.91.	____ kg	____	______
18	Mug	4.20.	______ dm2	4.44.	____ %	4.68.	____ kg	____	______	4.92.	____ kg	____	______
19	Gram, Arhar etc.	4.21.	______ dm2	4.45.	____ %	4.69.	____ kg	____	______	4.93.	____ kg	____	______
20	Spices (specify)………….	4.22.	______ dm2	4.46.	____ %	4.70.	____ kg	____	______	4.94.	____ kg	____	______
21	Spices (specify)………….	4.23.	______ dm2	4.47.	____ %	4.71.	____ kg	____	______	4.95.	____ kg	____	______
22	Spices (specify)………….	4.24.	______ dm2	4.48.	____ %	4.72.	____ kg	____	______	4.96.	____ kg	____	______
23	Spices (specify)………….	4.25.	______ dm2	4.49.	____ %	4.73.	____ kg	____	______	4.97.	____ kg	____	______
24	Spices (specify)………….	4.26.	______ dm2	4.50.	____ %	4.74.	____ kg	____	______	4.98.	____ kg	____	______

Code#	Each product below is the main produced on the area	How much of these products did you **SELL during this year/season (2006/2007)?** *Leave blank (do NOT write 0) if the crop is not planted* -E-				How much of these products did you **BUY for your family consumption during this year/season (2006/2007)?** *Leave blank (do NOT write 0) if the crop is not planted* -F-			
			Quantity	Price/unit (Taka)	Value (Taka)		Quantity	Price/unit (Taka)	Value (Taka)
01	Boro Paddy	4.99.	_____ kg	____	______	4.123.	_____ kg	____	______
02	Boro Rice	4.100.	_____ kg	____	______	4.124.	_____ kg	____	______
03	Aman Paddy	4.101.	_____ kg	____	______	4.125.	_____ kg	____	______
04	Aman Rice	4.102.	_____ kg	____	______	4.126.	_____ kg	____	______
05	Aus Paddy	4.103.	_____ kg	____	______	4.127.	_____ kg	____	______
06	Aus Rice	4.104.	_____ kg	____	______	4.128.	_____ kg	____	______
07	Wheat	4.105.	_____ kg	____	______	4.129.	_____ kg	____	______
08	Ata	4.106.	_____ kg	____	______	4.130.	_____ kg	____	______
09	Mustard/oil seeds	4.107.	_____ kg	____	______	4.131.	_____ kg	____	______
10	Potato	4.108.	_____ kg	____	______	4.132.	_____ kg	____	______
11	Veg (specify)……..	4.109.	_____ kg	____	______	4.133.	_____ kg	____	______
12	Veg (specify)……..	4.110.	_____ kg	____	______	4.134.	_____ kg	____	______
13	Veg (specify)……..	4.111.	_____ kg	____	______	4.135.	_____ kg	____	______
14	Veg (specify)……..	4.112.	_____ kg	____	______	4.136.	_____ kg	____	______
15	Veg (specify)……..	4.113.	_____ kg	____	______	4.137.	_____ kg	____	______
16	Masur	4.114.	_____ kg	____	______	4.138.	_____ kg	____	______
17	Khesari	4.115.	_____ kg	____	______	4.139.	_____ kg	____	______

Code#	Each product below is the main produced on the area	How much of these products did you **SELL during this year/season (2006/2007)?** *Leave blank (do NOT write 0) if the crop is not planted* -E-				How much of these products did you **BUY for your family consumption during this year/season (2006/2007)?** *Leave blank (do NOT write 0) if the crop is not planted* -F-			
			Quantity	Price/unit (Taka)	Value (Taka)		Quantity	Price/unit (Taka)	Value (Taka)
18	Mug	4.116.	_____ kg	____	______	4.140.	_____ kg	____	______
19	Gram, Arhar etc.	4.117.	_____ kg	____	______	4.141.	_____ kg	____	______
20	Spices (specify)………….	4.118.	_____ kg	____	______	4.142.	_____ kg	____	______
21	Spices (specify)………….	4.119.	_____ kg	____	______	4.143.	_____ kg	____	______
22	Spices (specify)………….	4.120.	_____ kg	____	______	4.144.	_____ kg	____	______
23	Spices (specify)………….	4.121.	_____ kg	____	______	4.145.	_____ kg	____	______
24	Spices (specify)………….	4.122.	_____ kg	____	______	4.146.	_____ kg	____	______

5. Asset ownership

House and Household Assets		Quantity/Number currently owned	Have you **sold any of the assets** during the **past 12 months**? **0**= No **1**= Yes	**If sold: Main reason for selling?** **1=** To repay debt **2=** To meet Hh expenditure **3=** Marriage or ceremony cost **4=** Cost of migration/ foreign travel **5** = Others specify	**If sold: Was this selling usual at that time of the year** 0=No 1=yes
5.1. Dwelling house		No.	|___|	|___|	|___|
5.2 Homestead land		dm2	|___|	|___|	|___|
5.3 Jewellery	1. Gold	Gram/Ana	|___|	|___|	|___|
	2. Silver	Gram/Ana	|___|	|___|	|___|
5.4. Electric appliances (radio, fan, fridge, TV…)		No.	|___|	|___|	|___|
5.5. Furniture (table. Beds, chairs…)		No.	|___|	|___|	|___|
5.6. Kitchen utensils		No.	|___|	|___|	|___|
5.7. Cereal stocks (production, purchase, gift, aid etc.)		Kg	|___|	|___|	|___|
Animal assets		**Quantity currently owned**	Have you **sold any animals** during the **past 12 months**? **0**= No **/ 1**= Yes	**If sold: Main reason for selling** **1=** Need for money **2=** Old age **3=** animal disease/sickness **4=** Infertility **5=** Lack of water **6=** Lack of fodder/animal feed/pasture **7=** Flood water/monsoon season **8=** Other reason *specify*	**If sold: Was this selling usual at that time of the year?** 0=No 1=yes
5.8. Cow/Oxen/Buffalo		No.	|___|	|___|	|___|
5.9. Goat/Sheep/Pig		No.	|___|	|___|	|___|
5.10. Poultry (chicken/duck/pigeon)		No.	|___|	|___|	|___|
Productive assets		**Quantity/Number currently owned**	Have you **sold any of the assets** during the **past 12 months**? **0**= No **/ 1**= Yes	**If sold:** What was the **main reason for selling** **1=** To repay debt **2=** To meet HH expenditure **3=** Marriage or ceremony cost **4=** Cost of migration/ foreign travel **5=** Other *specify*_______	**If sold: Was this selling usual at that time of the year** 0=No 1=yes
5.11. Boat / Trawler		No	|___|	|___|	|___|
5.12. Rickshaw / Bicycle /Van/motor cycle		No.	|___|	|___|	|___|
5.13. Fish pond		dm2	|___|	|___|	|___|
5.14. Shrimp gher		dm2	|___|	|___|	|___|
5.15. Agricultural land		dm2	|___|	|___|	|___|
5.16. Crop seeds		Kg	|___|	|___|	|___|
5.17. Trees / Orchard		No.	|___|	|___|	|___|
5.18. Agriculture machinery (tiller, sowing machine, plough, threshing machine, irrigation pump)		No.	|___|	|___|	|___|
5.19. Agricultural tools (shovel, axe, rake etc.)		No.	|___|	|___|	|___|
5.20. Fishing gear (nets, etc.)		No.	|___|	|___|	|___|

5.21. How long the cereal stock (rice, wheat, pulses, flour) will last for your family consumption? (Write 0 if less than 1 month)		|__|	|__|	|__|

6. EXPENDITURES (FOOD AND NON-FOOD) AND DEBTS

In local currency (Taka)		How much did you **spend LAST WEEK for your FOOD**?	How much did you **spend LAST MONTH** on:		
6.1.	Rice	____	6.15.	Firewood / charcoal	____
6.2.	Wheat	____	6.16.	Gas	____
6.3.	Other cereals	____	6.17.	Kerosene/ petrol	____
6.4.	Potatoes/sweet potatoes	____	6.18.	Housing (rent, repairs)	____
6.5.	Vegetable	____	6.19.	Water	____
6.6.	Pulses (Masur, Kesari etc)	____	6.20.	Health	____
6.7.	Edible oil	____	6.21.	Education	____
6.8.	Meat, poultry egg	____	6.22.	Transportation (for household own purposes)	____
6.9.	Milk & milk product	____	6.23.	Clothing, shoes	____
6.10.	Fish	____	6.24.	Soap, hygiene items	____
6.11.	Condi & spices	____	6.25.	Ceremonies, entertainment	____
6.12.	Fruits	____	6.26.	Reimbursement debts	____
6.13.	Sugar, molasses	____	6.27.	Any other non-food expenditures	____
6.14.	Miscellaneous (tea, soft drinks, bread, biscuit, fast food, betel nut, betel leaf	____			

6.28.	Have your current expenditures changed compared **to 12 months ago**? **1**= No change **2**= Decreased **3**= Increased	__
6.29.	By how much your total expenditure changed per month? *If no change write 0*	____ Tk

Which expenditures have changed? **1**= No change **2**= Decreased **3**= Increased						
	6.30.	Food & beverage	__	6.35.	Health	__
	6.31.	Energy (cooking, heating, lighting)	__	6.36.	Education	__
	6.32.	Housing & house rent	__	6.37.	Transportation	__
	6.33.	Cloth & footwear		6.38.	Other 2 (Specify)____________	
	6.34.	Other 1 (Specify)___	__			

6.39.	Do you have any **debt or credit to reimburse** at the moment?	**0**= No **1**= Yes	__ → ***If No, go to 7.1***
6.40.	Have you have contracted **new debts or credit in the past 6 months**?	**0**= No **1**= Yes	__ → ***If No, go to 6.43***
6.41.	What was the **main reason for new debts or credit**? **1**= To buy food **2**= To cover health expenses **3**= To pay school, education costs **4**= To buy agricultural inputs (seed, fertilizer, tools...) **5**= To buy animal feed, fodder, veterinary **6**= To buy animals **7**= To buy or rent land **8**= To buy clothes, shoes **9**= To pay for ceremonies **10** = to pay ticket/cover travel for migration **11**= to pay electricity bill **12**= to pay house rent **13**= to repair or build house **14**= Other reason (specify)_______________		__
6.42.	Who is the **main source of credit**? **1**= Relatives (neighbours, friends, parents, excluding 'free' remittances from migrants abroad) **2**= Traders/shop-keeper **3**= Bank/ Credit institution/Micro-credit project/Local cooperatives **4**= Money lender **5**= Other (*specify*)___________________		__
6.43.	**In which amount of time** do you think you will be able **to reimburse** your debts or credit?		__ months

7. SCHOOL ATTENDANCE

		Girls	Boys
7.1.	Did **ALL primary school-aged** children **regularly attend school** in the **past 12 months**?	**0**= No / **1**= Yes |___| **99** = not applicable	**0**= No / **1**= Yes |___| **99** = not applicable
		If Yes or 99 for girls or boys than go to 7.4, otherwise ask applicable questions	

What was the **main reason** for these children not attending regularly?		Girls		Boys
1= Sickness/handicap **2**= Cannot pay school fees, uniforms, textbooks **3**= Cannot pay transportation/ far away **4**= Absent teacher/ poor quality teaching **5**= Poor school facilities (building, toilets, etc.) **6**= Domestic household chores unpaid (e.g. child care, washing etc.) **7** = Child work for household unpaid (e.g. farming, family business) **8**= Child work for cash or food (e.g. casual work, petty trade, begging etc.) **9**= Early girl marriage **10**= No girl school/no female teacher available **11**= No boarding school available **12**= Not interested **13**= Other reasons _______________________ ; **99**= Not applicable	7.2.	|___|	7.3.	|___|

		Girls	Boys
7.4.	Did **ALL secondary** school-aged **children** regularly a**ttend school** in the **past 12 months**?	**0**= No / **1**= Yes |___| **99** = not applicable	**0**= No / **1**= Yes |___| **99** = not applicable
		If Yes or 99 for girls or boys than go to section 8, otherwise ask applicable questions	

What was the **main reason** for these children not attending regularly?		Girls		Boys
1= Sickness/handicap **2**= Cannot pay school fees, uniforms, textbooks **3**= Cannot pay transportation/ far away **4**= Absent teacher/ poor quality teaching **5**= Poor school facilities (building, toilets, etc.) **6**= Domestic household chores unpaid (e.g. child care, washing etc.) **7** = Child work for household unpaid (e.g. farming, family business) **8**= Child work for cash or food (e.g. casual work, petty trade, begging etc.) **9**= Early girl marriage **10**= No girl school/no female teacher available **11**= No boarding school available **12**= Not interested **13**= Other reasons _______________________ ; **99**= Not applicable	7.5.	|___|	7.6.	|___|

8. FOOD CONSUMPTION & DIET DIVERSITY

		Adults		Children 1-5 years	
Yesterday, how many meals were eaten by:		8.1.	|__|	8.2.	|__|
How does this **compare to usual?**	**1**= Less / **2**= Same / **3**= More	8.3.	|__|	8.4.	|__|

Do NOT count small quantities (less than 1 tea spoon)	**During how many days was the food item eaten in previous 7 days?** **0** = Not eaten **1**= 1 day **2**= 2 days **3**= 3 days **4**= 4 days **5**= 5 days **6**= 6 days **7**= 7 days		**What was the main source of the food in the PAST 7 DAYS?** **1**= Own crop/garden production; **2**= central market purchase **3** = local market / shop purchase **; 4** = Work for food **5**= Borrowing/debts; **6**= Gifts from neighbours/relatives **7**= Food aid; **8=** Barter or trade of goods/services **99**= Not eaten in past 7 day		Where do you **Usually obtain most of this food**? *Ask for each food listed, even if not consumed in the past 7 days*	
Rice	8.5.	|__|	8.19.	|__|	8.33.	|__|
Wheat	8.6.	|__|	8.20.	|__|	8.34.	|__|
Other cereals (maize…)	8.7.	|__|	8.21.	|__|	8.35.	|__|
Potatoes/sweet potatoes	8.8.	|__|	8.22.	|__|	8.36.	|__|
Vegetables	8.9.	|__|	8.23.	|__|	8.37.	|__|
Pulses (Masur, Kesari etc)	8.10.	|__|	8.24.	|__|	8.38.	|__|
Edible oil	8.11.	|__|	8.25.	|__|	8.39.	|__|
Meat, poultry egg	8.12.	|__|	8.26.	|__|	8.40.	|__|
Milk & milk product	8.13.	|__|	8.27.	|__|	8.41.	|__|
Fish	8.14.	|__|	8.28.	|__|	8.42.	|__|
Condi & spices	8.15.	|__|	8.29.	|__|	8.43.	|__|
Fruits	8.16.	|__|	8.30.	|__|	8.44.	|__|
Sugar, molasses (gur)	8.17.	|__|	8.31.	|__|	8.45.	|__|
Miscellaneous (tea, soft drinks, bread, biscuit, fast food, betel nut, betel leaf)	8.18.	|__|	8.32.	|__|	8.46.	|__|

9. SHOCKS AND COPING STRATEGIES

What have been your main difficulties or shocks in the past 12 months? ***Do NOT list, leave the household answer spontaneously.*** ***Once done, ask the household to rank the 3 most important ones***	**1st difficulty**		**2nd difficulty**		**3rd difficulty**	
1=Loss employment/reduced salary; **2**= Sickness/health expenditures **3**= Death household member/funerals; **4**= High food prices **5**= High fuel/transportation prices; **6**= Payment house rental **7**= Debt to reimburse; **8**= Irregular/unsafe drinking water **9**= Electricity/gas cuts; **10**= Insecurity/thefts **11**= Bad climate (poor harvest) **12**= environment problems (pollution, industries) **13 =** Floods, cyclones; **14**= Other shock (Specify)___________________ **99**= No 2nd or no 3rd difficulty mentioned	9.1.	|__|	9.2.	|__|	9.3.	|__|

9.4.	How severely has your household been affected by the recent food price increase?	Not at all affected .... 1 Mildly affected .... 2 Moderately affected........................ 3 Highly affected .... 4 Severely affected 5	|__|
9.5.	Over the **past 12 months**, were there months, in which you did not have enough food (rice, wheat, etc.) for your household	**0**= No, go to 9.7 **1**= Yes	|__|
9.6.	If yes, which were the months (put √)	NOVEMBER 2007	|_____|
		DECEMBER 2007	|_____|
		JANUARY 2008	|_____|
		FEBRUARY 2008	|_____|
		MARCH 2008	|_____|
		APRIL 2008	|_____|
		MAY 2008	|_____|
		JUNE 2008	|_____|
		JULY 2008	|_____|
		AUGUST 2008	|_____|
		SEPTEMBER 2008	|_____|
		OCTOBER 2008	|_____|
9.7.	Over the **past 12 months**, have there been **times when you did not have enough money** to cover other essential expenditures (health, cooking fuel, school etc.)?	**0**= No, go to 9.9 1= Yes	|__|
9.8.	If yes, which were the months (put √)	NOVEMBER 2007	|_____|
		DECEMBER 2007	|_____|
		JANUARY 2008	|_____|
		FEBRUARY 2008	|_____|
		MARCH 2008	|_____|
		APRIL 2008	|_____|
		MAY 2008	|_____|
		JUNE 2008	|_____|
		JULY 2008	|_____|
		AUGUST 2008	|_____|
		SEPTEMBER 2008	|_____|
		OCTOBER 2008	|_____|

Over the past 12 months, did you have to **do any of these things to meet food and other needs?**		**0**= No **1**= Yes
9.9.	Consume seed stocks held for the next season	|__|
9.10.	Decrease expenditures for fertilizer, pesticide, fodder, animal feed, vet. care….	|__|
9.11.	Sell domestic assets (radio, furniture, fridge, TV, carpet…)	|__|
9.12.	Sell productive assets (farm implements, sewing machine, motorbike, land…)	|__|

9.13.	Sell more animals than usual	|__|
9.14.	Mortgage productive assets	|__|
9.15.	Decrease expenditures for health care	|__|
9.16.	Take children out of school	|__|
9.17.	Seek alternative or additional jobs	|__|
9.18.	Increase the number of members out-migrating for work and/or food	|__|
9.19.	Borrow from bank or micro credit organizations (Grameen Bank, ASA, Proshika, BRAC)	|__|
9.20.	Borrow from friends and relatives	|__|
9.21.	Selling advanced labour	|__|

During the **past 30 days**, **has anyone in your household done any of these things?**		**0**= Never **1**= Seldom (less than 15 days out of 30) **3**= Often (more than 15 days out of 30) **4**= Always
9.22.	Rely on less preferred and less expensive food	|__|
9.23.	Borrow food,	|__|
9.24.	Food gift, or rely on help from friends or relatives	|__|
9.25.	Limit portion size at meals	|__|
9.26.	Restrict consumption by adults in order for small children to eat	|__|
9.27.	Reduce number of meals eaten in a day	|__|
9.28.	Skip entire days without eating	|__|
9.29.	Purchase food on credit, incur debts	|__|
9.30.	Begging or gleaning food from field	|__|
9.31.	Gather wild food	|__|
9.32.	Gather waste food from markets/restaurants	|__|
9.33.	Send household members to eat elsewhere	|__|

10. ASSISTANCE

10.1.	In December 2007, did your household purchase any subsidized rice from any government "fair price" outlets (e.g., BDR shops, any of the Open Market Sales outlets)?	|__|	No = 0, If **No, go to 10.4** Ye s= 1
10.2.	How many days did the household do so?	|__|	Days
10.3.	What was the quantity received per day?	|__|	Kg
10.4.	In March-April 2008, did your household purchase any subsidized rice from any government "fair price" outlets (e.g., BDR shops, any of the Open Market Sales outlets)?	|__|	No = 0, **If No, go to 10.7** Ye s= 1
10.5.	How many days did the household do so?	|__|	Days
10.6.	What was the quantity received per day?	|__|	Kg
10.7.	In June 2008, did your household purchase any subsidized rice from any government "fair price" outlets (e.g., BDR shops, any of the Open Market Sales outlets)?	|__|	No = 0, **If No, go to 10.10** Ye s= 1
10.8.	How many days did the household do so?	|__|	Days
10.9.	What was the quantity received per day?	|__|	Kg

In 2008 have you received the following assistance? ***Specifically ask** for each assistance below*		**0**= No **1**=Yes	If yes Assistance type & Quantity					**In 2007 did the Household receive any of these assistances**
			Cash Taka	Rice kg	Atta kg	Wheat kg	Other food (pulse, oil) kg	**0**= No **1**= Yes
10.10.	VGD	|__|						|__|

In 2008 have you received the following assistance? ***Specifically ask*** ***for each assistance below***		0= No 1=Yes	If yes Assistance type & Quantity					In 2007 did the Household receive any of these assistances
			Cash Taka	Rice kg	Atta kg	Wheat kg	Other food (pulse, oil) kg	0= No 1= Yes
10.11.	VGF	|__|						|__|
10.12.	TR (Test relief)	|__|						|__|
10.13.	GR (Grant relief)	|__|						|__|
10.14.	Rural Employment Opportunity for Public Asset (REOPA)	|__|						|__|
10.15.	Relief during disasters like flood/cyclone							|__|
10.16.	Food-for-work	|__|						|__|
10.17.	Cash-for-work	|__|						|__|
10.18.	School Feeding	|__|						|__|
10.19.	Primary education stipend	|__|						|__|
10.20.	Secondary education stipend	|__|						|__|
10.21.	Food for young/malnourished children or for pregnant/lactating women	|__|						|__|
10.22.	Freedom fighter allowance	|__|						|__|
10.23.	Old age allowance	|__|						|__|
10.24.	Widow allowance	|__|						|__|
10.25.	Cash transfers from social assistance programme (government, private, NGO)	|__|						|__|
10.26.	Free health care/drugs, from an NGO programme	|__|						|__|
10.27.	Micro-credit (NGO or other agency programme)	|__|						|__|
10.28.	Free seeds, fertilizer (including programme with pay back)	|__|						|__|
10.29.	Free agricultural tools	|__|						|__|
10.30.	Free fodder, animal feed	|__|						|__|
10.31.	Free veterinary services	|__|						|__|
10.32.	100-day employment programme	|__|						|__|
10.33.	Other assistance (*specify*) ____________________	|__|						|__|

11. NEEDS

At present, what are your priority requirements? *Do NOT list, leave the household answer spontaneously.* *Once done, ask the household to rank the 3 most important ones*	**1st priority**		**2nd priority**		**3rd priority**	
1= Food for young/malnourished children or other vulnerable groups **2**= Food for the household in general **3**= Cash transfers **4**= Credit **5**= Employment **6**= Increased wage, increased pension **7**= Seeds **8**= Fertilizer **9**= Pesticides **10**= Agricultural tools **11**= Fodder, animal feed **12**= Veterinary services **13**= Irrigation **14**= Fishing equipments **15**= Health services (infrastructures, staff), treatment (subsidies, free drugs) **16**= Clothes, shoes **17**= Security **18**= Other assistance (*specify*) ______	11.1.	|__|	11.2.	|__|	11.3.	|__|

12 – HEALTHCARE UTILIZATION AND NUTRITIONAL STATUS OF CHILDREN UNDER 5

*Ask only for children under 5 years - **Complete 1st child (column), and then move to next child***

		Child Name:____ Child ID :____ Child's mother's ID:____		Child Name:____ Child ID :____ Child's mother's ID:____		Child Name:____ Child ID :____ Child's mother's ID:____
CHILD QUESTIONNAIRE (CHILDREN 6-59 MONTHS)						
Sex of child – **1**= Male/ **2**= Female	12.1.	|__|	12.15.	|__|	12.29.	|__|
Date of birth	12.2.	__ __/__ __/__ __ __ __ *day / month / year*	12.16.	__ __/__ __/__ __ __ __ *day / month / year*	12.30.	__ __/__ __/__ __ __ __ *day / month / year*
Age in months	12.3.	|____| months	12.17.	|____| months	12.31.	|____| months
Was the **child sick in the 2 weeks before** the survey? **0**= No/ **1**= Yes	12.4.	|__| ***If No, go to 12.9***	12.18.	|__| ***If No, go to 12.23***	12.32.	|__| ***If No, go to 12.37***
What was the **child's main sickness**? **1**= Fever **2**= Repeated coughs/ breathing difficulties **3**= Diarrhoea **4**= Measles **5**=Other______	12.5.	|__|	12.19.	|__|	12.33.	|__|
Was the child **taken to a health service**? **0**= No/ **1**= Yes	12.6.	|__| ***If No, go to 12.8***	12.20.	|__| ***If No, go to 12.22***	12.34.	|__| ***If No, go to 12.36***
If child was **not taken**, why? **1**= Not serious **2**= Far away/lack transport **3**= Lack money **4**= Does not like/ distrust **5**= Other source of treatment was used **6**= Other (*specify*)	12.7.	|__|	12.21.	|__|	12.35.	|__|
If the child had diarrhoea, did you give him/her Oral Rehydratation Solution (ORS)? **0**= No/ **1**= Yes **99**= Did not have diarrhoea	12.8.	|__|	12.22.	|__|	12.36.	|__|
Did the child receive a vitamin A capsule during the past 6 months? *Show the capsule!* **0**= No/ **1**= Yes	12.9.	|__|	12.23.	|__|	12.37.	|__|
Did the child receive **breast milk** yesterday? **0**= No/ **1**= Yes	12.10	|__|	12.24.	|__|	12.38.	|__|
Did the child receive **animal milk** yesterday? **0**= No/ **1**= Yes	12.11	|__|	12.25.	|__|	12.39.	|__|
How many times did the child receive **breast milk or animal milk** yesterday?	12.12	|__|	12.26.	|__|	12.40.	|__|
Did the child receive **solid, semi-solid or soft foods** yesterday? **0**= No/ **1**= Yes	12.13	|__| ***If No, go to 12.43***	12.27.	|__| ***If No, go to 12.60***	12.41.	|__| ***If No, go to 12.77***
How many times did the child receive **food** yesterday?	12.14	|__|	12.28.	|__|	12.42.	|__|
What did the child **eat** yesterday**?**		**0**= No/ **1**= Yes		**0**= No/ **1**= Yes		**0**= No/ **1**= Yes

Wheat, bread, rice, pasta, biscuits	12.43.	|__|	12.60.	|__|	12.77.	|__|
Potatoes	12.44.	|__|	12.61.	|__|	12.78.	|__|
Beans, peas, lentils, nuts	12.45.	|__|	12.62.	|__|	12.79.	|__|
Milk, cheese, yogurt	12.46.	|__|	12.63.	|__|	12.80.	|__|
Meat, liver, kidney, chicken, fish	12.47.	|__|	12.64.	|__|	12.81.	|__|
Eggs	12.48.	|__|	12.65.	|__|	12.82.	|__|
Yellow/orange vegetables (pumpkin, carrots) & fruits plums)	12.49.	|__|	12.66.	|__|	12.83.	|__|
Other vegetables and fruits, including fruit juices (papaya, mango)	12.50.	|__|	12.67.	|__|	12.84.	|__|
Tea	12.51.	|__|	12.68.	|__|	12.85.	|__|
Plain or sugary water	12.52.	|__|	12.69.	|__|	12.86.	|__|
Infant formula	12.53.	|__|	12.70.	|__|	12.87.	|__|
Porridge	12.54.	|__|	12.71.	|__|	12.88.	|__|
Vitamins, mineral supplements, and/ or any medicine	12.55.	|__|	12.72.	|__|	12.89.	|__|
Has the child got **bilateral oedema**? **0**= No/ **1**= Yes	12.56.	|__|	12.73.	|__|	12.90.	|__|
What is the child's **weight**	12.57.	|__| |__| . |__| **kg**	12.74.	|__| |__| . |__| **kg**	12.91.	|__| |__| . |__| **kg**
What is the child's **height**	12.58.	|__||__| . |__| **cm**	12.75.	|__||__| . |__| **cm**	12.92.	|__||__| . |__| **cm**
What is the child's **MUAC**	12.59.	|__| |__| . |__| **mm**	12.76.	|__| |__| . |__| **mm**	12.93.	|__| |__| . |__| **mm**

Only attempt this question when the household has children < 6 months			
Is the child being currently breast fed?	12.94. |__| **0**= No/ **1**= Yes	12.95. |__| **0**= No/ **1**= Yes	12.96. |__| **0**= No/ **1**= Yes
Since yesterday was this child given anything to drink including water other than breast milk?	12.97. |__|	12.98. |__|	12.99. |__|
Since yesterday was this child given anything to eat including porridge or blended food/cereal other than breast milk?	12.100. |__|	12.101. |__|	12.102. |__|
This section should be filled out only for the mothers of children of ages 0 (birth) to 59 months of age or pregnant. *Make sure the mother of the child is answering to this question. If the mother is not present, skip this question.*	**Child's mother's ID:**____________	**Child's mother's ID:**____________	**Child's mother's ID:**____________
After the birth of your last child, did you received vitamin A capsule within six week of delivery. **Show the red 200,000 IU capsules to check with the mother being interviewed.**	12.103. |__|	12.104. |__|	12.105. |__|
Did you consume iron and folate tablets during your last or current pregnancy? **Show iron folate tablets to check with the mother being interviewed**	12.106. |__|	12.107. |__|	12.108. |__|
Measure the Mid Upper Arm Circumference (MUAC)	12.109. |__|.|__| mm	12.110. |__|.|__| mm	12.111. |__|.|__| mm

13. GENERAL HEALTH

13.1.	Over last two weeks has any person or persons in your household has become sick?	|__|	**0 = No, if NO, go to 13.5** **1 = Yes**

13.2. **Name**	13.3. **Sex** **1=Male** **2=Female**	13.4. **Type of disease /sickness** **1 = Fever** **2 =** coughs/ breathing difficulties **3**= Diarrhoea 4= Others (specify	13.5. Was treatment sought outside the house? **0 = No** **1 = Yes, if YES go to 13.7**	13.6. Why was treatment not sought? Minor illness no treatment required = 1 Lack of money = 2 Lack of transport = 3 Lack of time = 4 Religious opposition = 5 Family Objection = 6 Other (specify) = 7
01.	|__|	|__|	|__|	|__|
02.	|__|	|__|	|__|	|__|
03.	|__|	|__|	|__|	|__|
04.	|__|	|__|	|__|	|__|

13.7.	Has any of your household member died since Bengali new year/Boishak 1415/April 2008	|__|	**0=No, if NO stop here** **1=Yes, go to 13.7**

13.8. **Name**	13.9. **Sex** **1=Male** **2=Female**	13.10. **Reason of death** **1**= Diarrhoea (at least 3 watery stools/24 hours) **2**= Bloody diarrhoea **3**= Measles fever, rash, febrile **4**= Fever **5**= Lower respiratory tract infection (fever, productive cough, chest pain, difficulty breathing) **6**= Malnutrition **7**= Accident **8**= Others (specify__________________) **9**= Unknown	13.11. **Age of death** *(Write in number of months for under 2 and in number of years above 2 years)*
01.	|__|	|__|	|__|
02.	|__|	|__|	|__|
03.	|__|	|__|	|__|
04.	|__|	|__|	|__|

Ending Time: ☐☐ : ☐☐
Hour Minute

HIGH FOOD PRICE IMPACT ASSESSMENT IN URBAN AND RURAL AREAS OF BANGLADESH
- November 2008 -

SURVEY ON FOOD SECURITY AND NUTRITION ASSESSMENT OF THE IMPACTS OF HIGH FOOD PRICE IN BANGLADESH 2008

TRADER QUESTIONNAIRE

World Food Programme
IDB Bhaban (17th floor), Rokeya Sarani
Dhaka 1207, Bangladesh
and

UNICEF

and

MITRA AND ASSOCIATES
(Centre for Research and Consultancy)
2/17 Iqbal Road, Mohammadpur, Dhaka-1207, Bangladesh
Tel: 880-2-8118065/9115503, Email: mitra@citech.net, Fax: 880-2-9126806

HIGH FOOD PRICE IMPACT ASSESSMENT IN URBAN AND RURAL AREAS OF BANGLADESH
- November 2008 -

Trader Questionnaire

Questionnaire ID : |__||__||__||__||__||__||__|
District code: |__| Upazila code: |__| Village/Mohalla name: ______________________
Urban Area, Ward# |__||__| Name of the bazaar:______________________
Name of the shop:______________________ Owner of the Shop:______________________
Cluster number: |__||__||__| Trader questionnaire number: |__||__||__|
Type of trader: **Wholesaler = 1, Retailer/Shop keeper/Petty trader = 2** |__|
Date : |__||__| / |__||__| / |__||__||__||__| Team Number: |__||__|
day month year
Enumerator names :______________________ / ______________________ Code# |__||__|

<u>Instructions to the enumerators</u>: Visit the main market located in the selected enumeration area. If there is no market in the enumeration area, visit the market where most of the households of the enumeration area usually go to. To find out, you may want to talk to 2-3 key informants of the enumeration area (chairman, school head, civil servant…). Whence on the market, talk to a maximum of 5 traders. Select randomly 2 wholesalers and 3 retailers/shop keepers. The random selection process is based on the training received. If there is no wholesaler in the market, select 5 retailers/shop keepers. If there is less than 5 retailers/shop keepers, interview all the traders you find. If there are lots of different types of traders (e.g. cereal traders, vegetable/fruits traders, meat/poultry traders…) on the market, at least 2 cereals traders must be interviewed.

I – <u>TOP THREE PRODUCTS SOLD</u>

What are the top three products you are selling most frequently? *(e.g., if 100 customers come to your shop, what products most of them buy?)*

Commodity type		Product Code	Product name	Mark the code of the product here
Wheat	1.1.	1	High priced atta (Packet atta)	|__|
	1.2.	2	Medium priced atta	|__|
	1.3.	3	Low priced atta	|__|
	1.4.	4	Wheat flour	|__|
Rice	1.5.	5	Local rice (low quality/coarse rice)	|__|
	1.6.	6	Local rice (medium quality)	|__|
	1.7.	7	Local rice (high quality)	|__|
	1.8.	8	Imported rice (low quality/coarse rice)	|__|
	1.9.	9	Imported rice (medium quality)	|__|
	1.10.	10	Imported rice (high quality)	|__|
Dal	1.11.	11	High priced dal (Masur/Mung)	|__|
	1.12.	12	Medium priced dal (Bolder/Mashkalai/Motor)	|__|
	1.13.	13	Low priced dal (Kheshari/Arhar/Anchor)	|__|
Others	1.14.	14	Potatoes	|__|
	1.15.	15	Edible oil	|__|
	1.16.	16	Milk	|__|
	1.17.	17	Egg	|__|
	1.18.	18	Sugar	|__|
	1.19.	19	Other 1 (Specify)______________________	|__|
	1.20.	20	Other 2 (Specify)______________________	|__|
	1.21.	21	Other 3 (Specify)______________________	|__|
	1.22.	22	Other 4 (Specify)______________________	|__|
	1.23.	23	Other 5 (Specify)______________________	|__|

II –PRICES OF THE TOP THREE PRODUCTS SOLD

Code of the product *(Product codes are the ones selected in section 1)*	**Mark unit here** *Check carefully*	**At what price do you sell the product, currently?** **PER UNIT** *(Check carefully)* ***(in Taka)***		**At what price were you selling the product 6 months ago?** **PER UNIT** *(Check carefully)* ***(in Taka)***		**At what price were you selling the product 12 months ago?** **PER UNIT** *(Check carefully)* ***(in Taka)***	
Product 1	|_____|	12.77.	|_______|	2.4.	|_______|	2.7.	|_______|
Product 2	|_____|	12.78.	|_______|	2.5.	|_______|	2.8.	|_______|
Product 3	|_____|	12.79.	|_______|	2.6.	|_______|	2.9.	|_______|

Code of the product *(Product codes are the ones selected in section 1)*	**Mark unit here** *Check carefully*	**At what price do you buy the product, currently?** **PER UNIT** *(Check carefully)* ***(in Taka)***		**At what price were you buying the product 6 months ago?** **PER UNIT** *(Check carefully)* ***(in Taka)***		**At what price were you buying the product 12 months ago?** **PER UNIT** *(Check carefully)* ***(in Taka)***	
Product 1	|_____|	2.10.	|_______|	2.13.	|_______|	2.16.	|_______|
Product 2	|_____|	2.11.	|_______|	2.14.	|_______|	2.17.	|_______|
Product 3	|_____|	2.12.	|_______|	2.15.	|_______|	2.18.	|_______|

For commodities whose prices have increased compared to last year, what are the main reasons of these price increases? *(Don't read the reasons. Let the trader respond, unless necessary. Product codes are the ones selected in section 1. Write down the code)*

Codes of the reason	**Reason**	**Product 1**		**Product 2**		**Product 3**	
1	Increased food price at the origin (e.g. wholesaler, other trader, millers, importers, producer)	2.19.	|__|	2.28.	|__|	2.37.	|__|
2	Increased transportation cost	2.20.	|__|	2.29.	|__|	2.38.	|__|
3	Increased taxes	2.21.	|__|	2.30.	|__|	2.39.	|__|
4	High credit interest rate	2.22.	|__|	2.31.	|__|	2.40.	|__|
5	High storage and handling costs	2.23.	|__|	2.32.	|__|	2.41.	|__|
6	Lower availability of commodities for sale compared to households' demand	2.24.	|__|	2.33.	|__|	2.42.	|__|
7	Hoarding/stock holding/syndicates/cartels	2.25.	|__|	2.34.	|__|	2.43.	|__|
8	Increased production cost (fertilizer, fuel, seeds…)	2.26.	|__|	2.35.	|__|	2.44.	|__|
9	Other reason (specify) ____________________	2.27.	|__|	2.36.	|__|	2.45.	|__|

III –SALES OF THE TOP THREE PRODUCTS

Code of the product *(Product codes are the ones selected in section 1)*	**Mark unit here** *Check carefully*	**What are the average quantities you are selling in one week at the moment/ currently?**		**What are the average quantities you were selling in one week 6 months ago?**		**Before, what are the average quantities you were selling in one week during the same period of the year, USUALLY**	
Product 1	|_____|	3.1.	|________|	3.4.	|________|	3.7.	|________|
Product 2	|_____|	3.2.	|________|	3.5.	|________|	3.8.	|________|
Product 3	|_____|	3.3.	|________|	3.6.	|________|	3.9.	|________|

Has the volume of your sales increased or decreased over the last 12 months? *(Product codes are the ones selected in section 1)*						
Product 1	3.10.	**1**= Increase **2**= Decrease **3**=No change	|__|	3.13.	**If increase or decrease, by how much?** *Use proportional pilling if needed*	|_____| %
Product 2	3.11.	**1**= Increase **2**= Decrease **3**=No change	|__|	3.14.	**If increase or decrease, by how much?** *Use proportional pilling if needed*	|_____| %
Product 3	3.12.	**1**= Increase **2**= Decrease **3**=No change	|__|	3.15.	**If increase or decrease, by how much?** *Use proportional pilling if needed*	|_____| %

If there has been an INCREASE or a DECREASE in sales, what was the MAIN reason for this? *(Don't read the list, unless necessary. Product codes are the ones selected in section 1. Write down the code)*

Codes of the reason	**Reason**	**Product 1**		**Product 2**		**Product 3**	
1	Poor harvest/Stock-building by consumers	3.16.	|__|	3.25.	|__|	3.34.	|__|
2	Lower prices	3.17.	|__|	3.26.	|__|	3.35.	|__|
3	Purchases of Institutional buyers (Government, NGO, others)	3.18.	|__|	3.27.	|__|	3.36.	|__|
4	Traders from other regions have come to buy	3.19.	|__|	3.28.	|__|	3.37.	|__|
5	Consumers relying on their own production/stocks	3.20.	|__|	3.29.	|__|	3.38.	|__|
6	Food assistance (including subsidized sales)	3.21.	|__|	3.30.	|__|	3.39.	|__|
7	Arrival of the new harvest	3.22.	|__|	3.31.	|__|	3.40.	|__|
8	Higher prices	3.23.	|__|	3.32.	|__|	3.41.	|__|
9	Other reason (specify) ____________________	3.24.	|__|	3.33.	|__|	3.42.	|__|

3.43. **Has there been a change in buying behaviour of the customers over the last 12 months?**			**0=** No **1=** Yes |__| *If No, go to section 4*	**If Yes, what is the proportion (%) of your customers that apply this behaviour?**	
What type of changes in buying behaviour do you see?	3.44.	People buy cheaper foods	**0=** No **1=** Yes |__|	3.47.	|________| %
	3.45.	People buy very small quantities	**0=** No **1=** Yes |__|	3.48.	|________| %
	3.46.	Other reason (specify) _______________	**0=** No **1=** Yes |__|	3.49.	|________| %

IV. SOURCES AND CURRENT AVAILABILITY OF THE TOP THREE PRODUCTS

Where do you usually purchase the three main products you are selling?				
Code of the product *(Product codes are the ones selected in section 1)*	**Currently at this period?** **1**= Own production **2**= Individual farmers **3**= Cooperative / farmer associations **4**= Middlemen **5**= Wholesalers/Millers (excluding Importers) **6**= Importers **7** = Other (specify) _______________		**Usually at the same period?** **1**= Own production **2**= Individual farmers **3**= Cooperative / farmer associations **4**= Middlemen **5**= Wholesalers/Millers (excluding Importers) **6**= Importers **7** = Other (specify) _______________	
Product 1	4.1.	|__|	4.4.	|__|
Product 2	4.2.	|__|	4.5.	|__|
Product 3	4.3.	|__|	4.6.	|__|

How many days do your stocks last? *(Product codes are the ones selected in section 1)*		
Product 1	4.7.	|__||__||__| days
Product 2	4.8.	|__||__||__| days
Product 3	4.9.	|__||__||__| days

Has the total stock level of these top three products increased or decreased, compared to: *(Product codes are the ones selected in section 1)*						
Six months ago?				**A year ago at the same period?**		
Product 1	4.10.	**1**= Increase **2**= Decrease **3**=No change	|__|	4.13.	**1**= Increase **2**= Decrease **3**=No change	|__|
Product 2	4.11.	**1**= Increase **2**= Decrease **3**=No change	|__|	4.14.	**1**= Increase **2**= Decrease **3**=No change	|__|
Product 3	4.12.	**1**= Increase **2**= Decrease **3**=No change	|__|	4.15.	**1**= Increase **2**= Decrease **3**=No change	|__|

What are the main causes of the changes in stock levels? *(Product codes are the ones selected in section 1. Please write down the code. Don't list unless necessary)*

Code of the reason	Reason	Product 1		Product 2		Product 3	
1	Import restrictions (e.g. ban on Indian imports)	4.16.	|__|	4.26.	|__|	4.36.	|__|
2	Import liberalization	4.17.	|__|	4.27.	|__|	4.37.	|__|
3	Export restrictions	4.18.	|__|	4.28.	|__|	4.38.	|__|
4	Export liberalization	4.19.	|__|	4.29.	|__|	4.39.	|__|
5	Bumper crop	4.20.	|__|	4.30.	|__|	4.40.	|__|
6	Lower production locally	4.21.	|__|	4.31.	|__|	4.41.	|__|
7	Scarcity of credit for business	4.22.	|__|	4.32.	|__|	4.42.	|__|
8	Increased credit availability for business	4.23.	|__|	4.33.	|__|	4.43.	|__|
9	Hoarding/stock holding	4.24.	|__|	4.34.	|__|	4.44.	|__|
10	Other reason (specify) ___________________	4.25.	|__|	4.35.	|__|	4.45.	|__|

How easy is it for you to obtain the top three products you are selling

Code of the product *(Product codes are the ones selected in section 1)*	**Now/Currently?** **1**= Not available **2**= Irregular/Less quantities than demanded **3**= Available		**6 months ago?** **1**= Not available **2**= Irregular/Less quantities than demanded **3**= Available		**12 months ago at the same period?** **1**= Not available **2**= Irregular/Less quantities than demanded **3**= Available	
Product 1	4.46.	|___|	4.49.	|___|	4.52.	|___|
Product 2	4.47.	|___|	4.50.	|___|	4.53.	|___|
Product 3	4.48.	|___|	4.51.	|___|	4.54.	|___|

V. CREDIT PRACTICES

5.1.	Do you **usually get credit to purchase the commodities** you are selling?	**0**= No **1**= Yes **99** = don't know	|__| ***If No or don't know, go to 5.3***
5.2.	If yes, **who mainly provides you with credit?**	**1**= Other traders providing the commodities **2**= Money lenders **3**= Bank, credit union, cooperative **4**= NGO programme **5**= Relatives **6**= Other (specify) _______________	|__|
5.3.	Have there been **changes in your access to credit this year compared to last year?**	**1**= Same **2**= Less than usual **3** = More than usual **4**= Not applicable **5**= Other reason: _______________	|__|
5.4.	What is the **current <u>monthly</u> interest rate for you to reimburse?**	|___| % per month	
5.5.	Has the **interest rate changed compared to last year?**	**1**= Same **2**= Lower this year **3** = Higher this year **4**= Not applicable	|__|
5.6.	Do you **give credit to people who are buying from you?**	**0**= No **1**= Yes **99** = don't know	|__| ***If No or don't know, go to 6.1***
5.7.	Have there been **changes in the number of people requesting to buy on credit now compared to last year?**	**1**= Same **2**= Less are asking credit **3** =More are asking credit	|__|

VI – DIFFICULTIES FOR TRADING

What are your main difficulties with trade at the moment? *(Please write the code. Don't list, unless necessary)*		**Write the code here**		
Code of the difficulty	**Difficulty**			
1=	High cost of fuel/Cost of transportation	6.1.		__
2=	High cost of commodities to purchase for sale	6.2.		__
3=	Decreased/lack of credit	6.3.		__
4=	Lack of capital	6.4.		__
5=	Increased cost of credit/high interest rates	6.5.		__
6=	Decreased / low purchasing power of people to buy commodities	6.6.		__
7=	Lack of storage facilities	6.7.		__
8=	Lack of transportation means	6.8.		__
9=	High taxes	6.9.		__
10=	Poor road conditions	6.10.		__
11=	Food assistance	6.11.		__
12=	Other (Specify): ______________________________	6.12.		__

VII – RESPONSE CAPACITY TO INCREASED DEMAND OF THE TOP THREE PRODUCTS

How long would it take for you to increase the volume of products you are selling the most, if demand increases? *(Product codes are the ones selected in section 1)*	**1**= Less than 2 weeks **2**= between 2 and 4 weeks **3**= between 1 and 2 months **4**= More than 2 months **5** = Would not be able to increase supplies **6**= Does not know	
Product 1	7.1.	|___|
Product 2	7.2.	|___|
Product 3	7.3.	|___|

VIII – FUTURE PRICE PERSPECTIVES

In your opinion, how will the prices of the top three products you are selling, evolve in the next six months? *(Product codes are the ones selected in section 1)*						
Product 1	8.1.	**1**= Increase **2**= Decrease **3**=No change	|__|	8.2.	**If increase or decrease, by how much?** *Use proportional pilling if needed*	|______| %
If there will be an <u>INCREASE</u> or a <u>DECREASE</u> in prices, what is the MAIN reason for this? (fill with codes below)					8.3.	|__|
Product 2	8.4.	**1**= Increase **2**= Decrease **3**=No change	|__|	8.5.	**If increase or decrease, by how much?** *Use proportional pilling if needed*	|______| %
If there will be an <u>INCREASE</u> or a <u>DECREASE</u> in prices, what is the MAIN reason for this? (fill with codes below)					8.6.	|__|
Product 3	8.7.	**1**= Increase **2**= Decrease **3**=No change	|__|	8.8.	**If increase or decrease, by how much?** *Use proportional pilling if needed*	|______| %
If there will be an <u>INCREASE</u> or a <u>DECREASE</u> in prices, what is the MAIN reason for this? (fill with codes below)					8.9.	|__|

Codes
1= Lean season (increased households demand) **2**= Food assistance (increased, including subsidized sales)
3= Good harvest (Bumper crop) **4**= Poor harvest (lower production) **5**= Export restrictions (reduced export volumes)
6=Export liberalization (increased export volumes) **7**= Import restrictions (reduced import volumes)
8= Import liberalization (increased import volumes) **9**= Other reason (specify) ______________________
99=Don't know

Appendix B Data Overview – Summary statistics

Mozambique

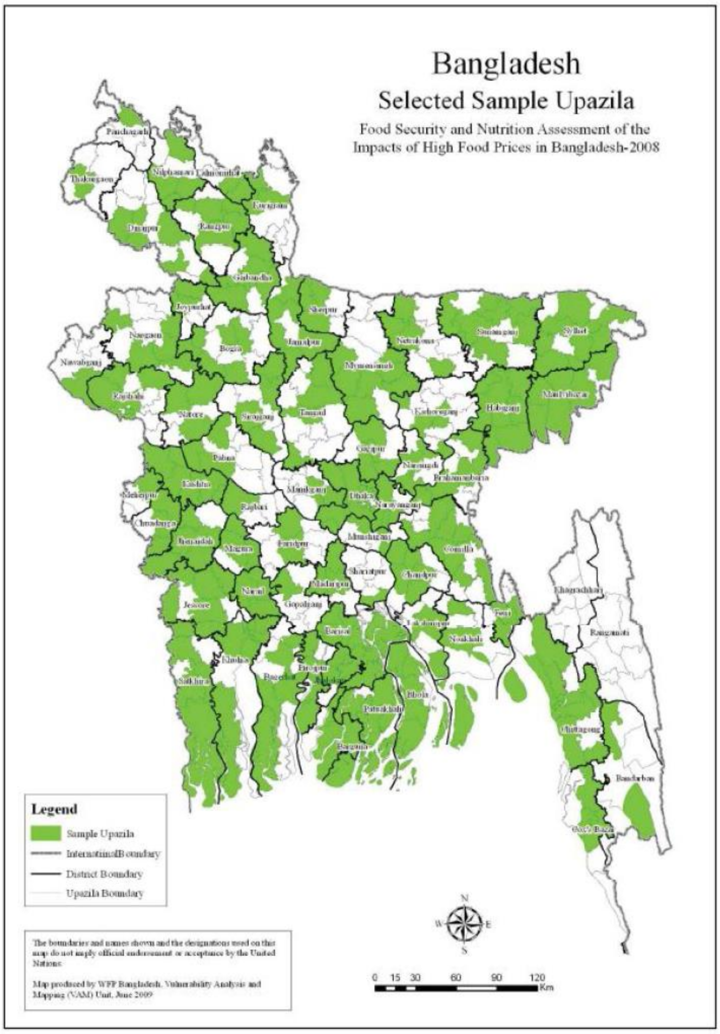
Variable	Observations	Mean	Std. Dev.	Min	Max
in variables					
MCES	10605	0.43	0.43	0.001	2.994
HHDS	10697	6.05	2.00	1	12
WHZ	7,575	0.18	1.52	-4.96	5
HAZ	7,623	-1.61	1.69	-5	4.99
WAZ	8,034	-0.80	1.38	-5	4.89
# of meals (adults)	10830	3.27	0.65	1	4
Food Insufficiency	10799	1.61	0.51	1	3
ısehold head characteristics					
Head of the HH is a man	10832	0.69	0.46	0	1
Age	10813	42.23	14.98	13	105
Education years	10182	2.30	1.05	1	17
ld's and Mothers' characteristics and care					
Age (in months)	7536	28.89	16.44	0	60
Child is a boy	7536	0.49	0.50	0	1
Birth Order	7536	1.41	0.66	1	6
Mother's age	7536	30.57	8.05	12	50
Mother's Education (in years)	7363	3.93	2.65	0	12
Duration of Breast feeding (in months)	7363	2.05	2.76	0	31
ısehold characteristics					
Household Size	10832	4.72	2.51	1	34
Members with disabilities	10832	0.93	0.26	0	1
Age difference (main woman to main man of the HH)	10090	-4.55	6.82	-61	34
Age dependency ratio, young (as a percentage of working-age HH members)	10814	0.18	0.21	0	1
Age dependency ratio, old (as a percentage of working-age HH members)	10465	0.07	0.24	0	3
ısehold Wealth					
nthly household expenditure by expenditure quintile					
Q1	2132	243.05	75.17	23.36	356.07
Q2	2143	438.04	52.57	322.53	537.31
Q3	2129	631.83	63.05	487.74	762.11
Q4	2128	926.35	117.62	688.74	1178.41
Q1	2129	2511.591	3297.521	1084.179	81930.48
ısehold Economic Activity and Assests					
Sale of agricultural products	10832	0.24	0.43	0	1
Land Ownership	10832	0.74	0.44	0	1
House Ownership	10831	0.91	0.29	0	1
Livestock Ownership	10751	0.55	0.50	0	1
ısing conditions					
High quality Roof	10793	0.43	0.49	0	1
High quality Floor	10794	0.35	0.48	0	1
Improved sanitation	10832	0.26	0.44	0	1
Safe drinking water	10832	0.19	0.39	0	1
Access to electricity	10832	0.22	0.41	0	1
nmunity/village characteristics					
Vicinity to the market	10832	0.75	0.43	0	1
Distance to main road (in Km)	10446	5.83	17.98	0	415
sonality and Location					
Maize lean season	10661	0.51	0.50	0	1
Rural	10832	0.52	0.50	0	1

Bangladesh

Indicator	%
Total no. of households assessed	10,378
Mean household size, average no. of persons	5
Proportion of female-headed households	8
Total no. of individuals assessed	51,591
Total no. of children 0-59 months assessed	5,379
Acute, global malnourished	13.5
Acute, severe malnourished	3.4
Underweight, global malnourished	37.4
Underweight, severe malnourished	12.3
Chronic, global malnourished	48.6
Chronic, severe malnourished	20.1
Proportion of malnourished women by MUAC	18.2
Proportion of severely malnourished women by MUAC	8.9
Children 9-59 months who received Vitamin A supplementation in past 6 months	76.5
Women who received Vitamin A supplementation 6 weeks postpartum	34.0
Women who received iron/folate supplementation in last/current pregnancy	50.3
Proportion of children exclusively breastfed to six months	48.7
Proportion of children being breastfed at one year	93.2
Proportion of children being breastfed at two years	89.2
Proportion of children who received minimum meal frequency	52.2
Proportion of children who received minimum diet diversity	35.5
Proportion of children who received minimum acceptable diet	19.5
Proportion of children reportedly ill 2 weeks prior to assessment	48.6
Proportion of children reportedly with diarrhoea 2 weeks prior to assessment	15.9
Proportion of children reportedly with respiratory illness 2 weeks prior to assessment	21.1
Proportion of children reportedly with fever 2 weeks prior to assessment	52.3
Proportion of households reporting illness 2 weeks prior to assessment	50.8
Under 5 mortality rate as deaths/10,000/day	0.66
Crude mortality rate as deaths/10,000/day	0.22

Source: WFP et al. 2009

Appendix C Sample upazilas where survey was conducted



Source: BHFSNA Report (WFP et al. 2009).

Appendix D Poisson Justification

A number of recent studies have used count data models to analyse the association of dietary diversity scores (DDS) with other exogenous variables (Hirvonen 2016, Shibathu 2015, Snapp 2014).

While most of the papers do not explicitly justify their use of poisson estimators for DDS, for example Hirvonen illustrates how the Poisson distribution fits the unconditional distribution of the data he is using extremely well (Fig D. 1). In his study on dietary diversity in Ethiopia, Hirvonen (2016) uses Children Dietary Diversity score to assess feeding practices of children between 6 and 23 months of age. This dietary diversity score includes the following seven food group categories: grains, roots and tubers (e.g. barley, enset, maize, teff, and wheat); legumes and nuts; dairy products (milk, yogurt, cheese); flesh foods (meat, poultry and fish products); eggs; Vitamin A rich fruits and vegetables; and other fruits and vegetables. Totalling the number of food groups consumed by a child yields a dietary diversity score ranging in value from zero to seven.

FigureD. 1 Fitting a Poisson distribution on DDSs (Hirvonen 2016)

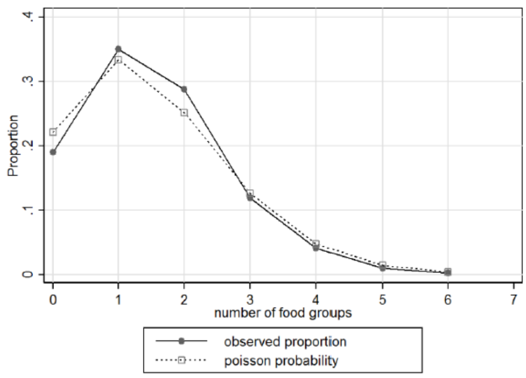
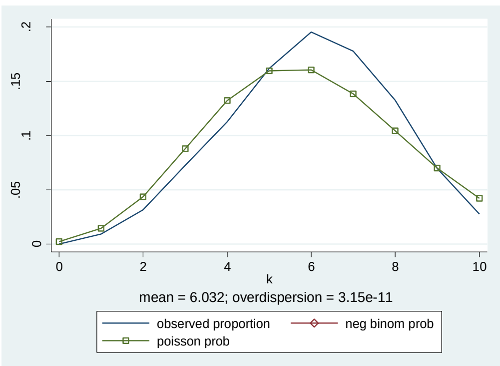


Figure D.2 repeats the same exercise and plots the distribution of HDDS of the Mozambican case study against Poisson distributions.

Figure D.2 Fitting a Poisson distribution on the HDDS data used to validate the MCES



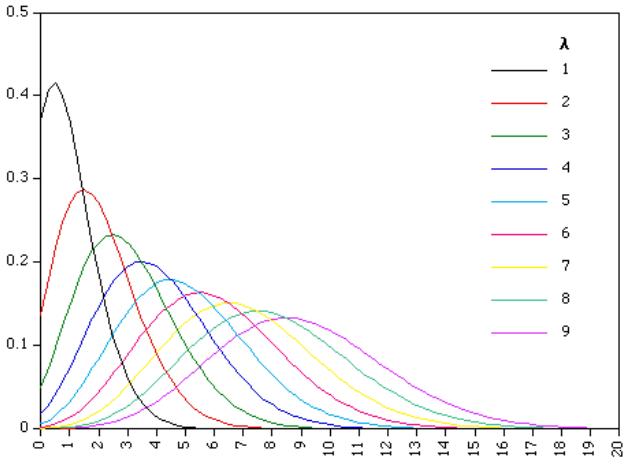
The Mozambique data fits the poisson distribution reasonable well however, data do not exhibit a skewed shape with a preponderance of zeros typical of the Poisson distribution. Additionally, one of the fundamental assumptions of the Poisson model (that the mean of the outcome variable Y_{ij} is equal to its variance) does not fully hold, as the variance is smaller than the mean.

Table D1 Summary statistics of HDDS.

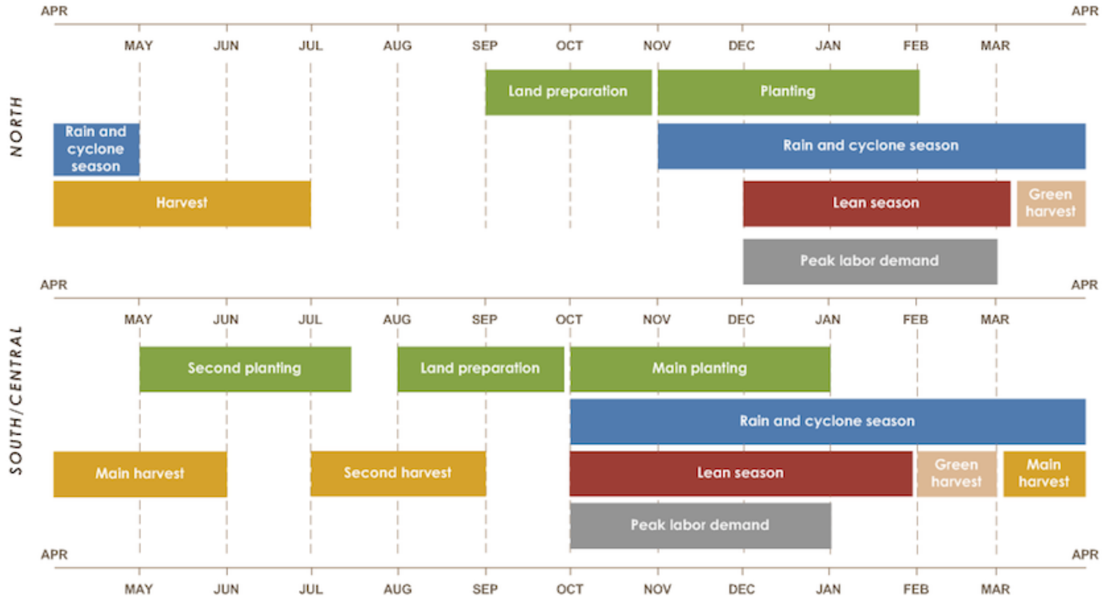
	Observations	**Mean**	**Variance**
Mozambique	10757	6.031979	4.009762

On the other hand, as the rate of occurrence (lamda) increases the Poisson curve tends to "look" like a Normal distribution and less skewed, (Fig D2). Infact, most of the demonstrations of perfectly fitting Poisson distribution are based on either ad hoc built data or relatively small datasets.

Figure D.3 The Poisson distribution



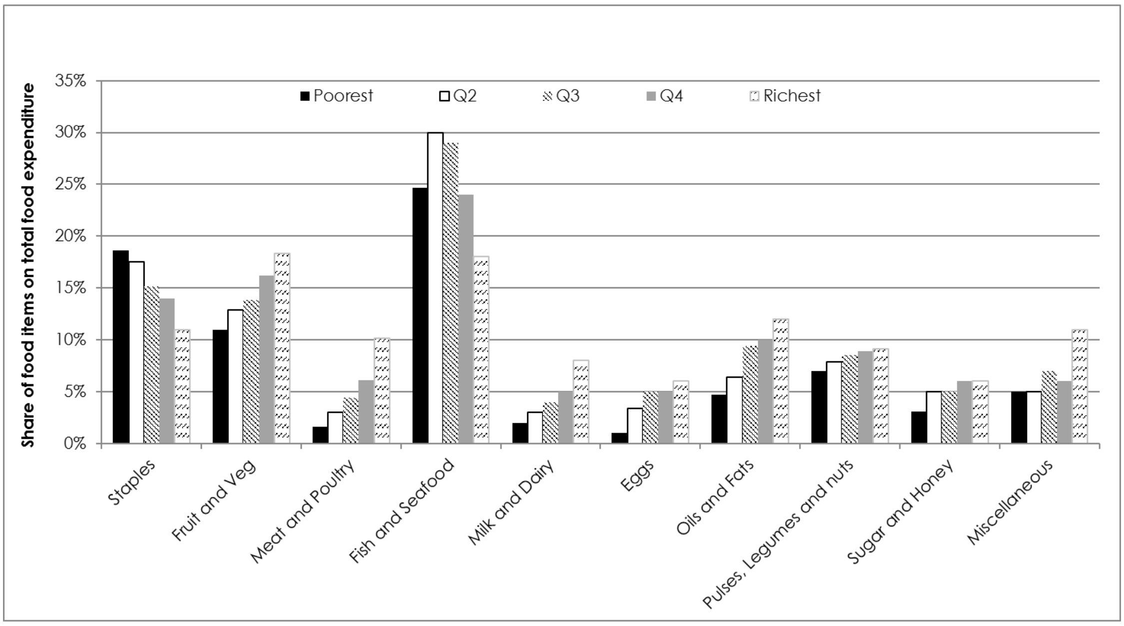
Appendix E Mozambique Crop Calendar



Survey Quarters IOF2008-09					
	Q3	Q4	Q1	Q2	Q3

Source: FEWS NET (http://www.fews.net/southern-africa/mozambique - accessed on 12 May 2017)

Appendix F Food Expenditure Pattern – Mozambique



Note: Staples include cereals and tuber flours (maize, wheat, sorghum, millet, mandioca and others), tubers (sweet potato, fresh and dry mandioca), and cereals -in grains- (rice, maize, wheat, oat, sorghum, millet, rye and barley).

Source: Author, using IOF 2008-2009 data

Appendix G Full Regression Results

Mozambique

Table G 1 Regression results – MCES and HDDS and SAFI indicators - Mozambique

	Poisson	OL	OL
VARIABLES	HDDS	meals_number	food_suff
MCES	-0.257***	-0.910***	-0.830***
	(0.00876)	(0.0536)	(0.0582)
Sunflower_oil__price	0.000122***	-0.000491	-6.79e-05
	(3.83e-05)	(0.000382)	(0.000351)
Dried_fish_price	0.000208***	-0.00122***	0.000841*
	(6.87e-05)	(0.000464)	(0.000506)
Serra_fish_price	3.15e-05	0.000961	0.00489***
	(0.000138)	(0.000955)	(0.00116)
hhsize	0.0237***	0.124***	0.0242**
	(0.00124)	(0.00973)	(0.00950)
HSex	-0.0436***	-0.296***	-0.396***
	(0.00648)	(0.0456)	(0.0468)
hage	-0.00135***	-0.00518***	-0.00275
	(0.000250)	(0.00175)	(0.00188)
Aged_DepRat	-0.0289**	0.156	-0.0507
	(0.0142)	(0.0956)	(0.0972)
Young_DepRat	-0.00584	0.0277	-0.0543
	(0.0147)	(0.101)	(0.111)
land_ownership	-0.0666***	-0.576***	-0.436***
	(0.00812)	(0.0626)	(0.0642)
House_ownership	0.00207	0.0147	-0.0168
	(0.0107)	(0.0827)	(0.0793)
livestock_ownership	0.000914	0.173***	0.279***
	(0.00639)	(0.0453)	(0.0488)
Sale_agr_crp	0.0262***	0.181***	0.399***
	(0.00711)	(0.0495)	(0.0553)
Dist_mainroad	-0.00133***	-0.00128*	-0.00229*
	(0.000221)	(0.000703)	(0.00134)
news	-0.0731***	0.0266	-0.229***
	(0.00406)	(0.0288)	(0.0311)
Urban	0.155***	0.439***	0.324***
	(0.00738)	(0.0502)	(0.0547)
maize_lean_season	0.0524***	0.181***	0.434***
	(0.00564)	(0.0399)	(0.0425)
Constant	1.971***		
	(0.0225)		
Constant cut1		-5.268***	-1.157***
		(0.191)	(0.168)
Constant cut2		-2.838***	3.786***
		(0.163)	(0.189)
Constant cut3		0.152	
		(0.156)	
Robust standard errors in parentheses			
*** p<0.01, ** p<0.05, * p<0.1			

OL: Ordered Logistic model

Table G 2 Regression results – MCES and Child Anthropometrics - Mozambique

	OLS	OLS
VARIABLES	whz06	haz06
MCES	-0.178**	-0.204**
	(0.0813)	(0.0924)
Sunflower_oil__price	-0.000630*	-0.000440
	(0.000371)	(0.000426)
Serra_fish_price	0.00145	-0.00169
	(0.00126)	(0.00149)
Dried_fish_price	0.000315	8.69e-05
	(0.000609)	(0.000662)
Child_Sex	-0.125**	-0.259***
	(0.0503)	(0.0584)
Child_age_group	0.00371	-0.192***
	(0.0203)	(0.0223)
BO	-0.0791*	0.273***
	(0.0470)	(0.0521)
child_ill	0.335***	0.123*
	(0.0568)	(0.0679)
safe_water	0.0435	-0.0937
	(0.0895)	(0.100)
improved_sanit	-0.0384	0.0341
	(0.0787)	(0.0870)
Breastfeed_months	0.0404***	-0.0351***
	(0.00927)	(0.0110)
hgender1	0.0328	-0.0546
	(0.0624)	(0.0715)
heduc1	0.0567*	0.114***
	(0.0297)	(0.0344)
hhsize	0.00446	-0.0159
	(0.0141)	(0.0167)
hage	0.00387	0.00616**
	(0.00262)	(0.00313)
share_of_kids	0.119	-0.491**
	(0.176)	(0.223)
Aged_DepRat	0.0547	-0.149
	(0.154)	(0.218)
land_ownership	-0.128	-0.176*
	(0.0878)	(0.0983)
livestock_ownership	0.0283	-0.00866
	(0.0609)	(0.0696)
Sale_agr_crp	-0.0944	0.0513
	(0.0652)	(0.0766)
maize_lean_season	-0.271***	0.120**
	(0.0514)	(0.0610)
Urban	0.0701	0.165**
	(0.0686)	(0.0797)
news	0.0458	0.268***
	(0.0396)	(0.0461)
Constant	-0.701***	-1.725***
	(0.269)	(0.303)
R-squared	0.036	0.068
Robust standard errors in parentheses		
*** p<0.01, ** p<0.05, * p<0.1		

Bangladesh

Table G 3. Regression results – MCES and HDDS and SAFI indicators – Bangladesh

	OLS	OL	OL
VARIABLES	Food Consumption Score	N. of meals-Adults	N. of meals-Children
MCES_new	-27.16***	-1.536***	-1.343***
	(7.314)	(0.514)	(0.398)
dal_low_price	0.00564	0.0136***	0.0132***
	(0.0156)	(0.00356)	(0.00216)
edible_oil_price	0.0368**	-0.0115***	-0.00189
	(0.0158)	(0.00316)	(0.00250)
hhsize	1.105***	0.0464**	0.0338**
	(0.119)	(0.0224)	(0.0141)
Sex	0.672	0.0309	-0.0874
	(0.765)	(0.165)	(0.136)
Age	0.124***	-0.000401	-0.00688***
	(0.0149)	(0.00305)	(0.00248)
Educ	10.20***	0.845***	0.127**
	(0.419)	(0.0861)	(0.0578)
empl_status	5.962***	0.737***	0.222***
	(0.492)	(0.0945)	(0.0749)
dependency_ratio	-2.351***	-0.163***	-0.0284
	(0.311)	(0.0578)	(0.0408)
M_status	-0.669*	-0.150*	0.0172
	(0.386)	(0.0829)	(0.0995)
garden_cultiv	3.126***	0.0245	0.0672
	(0.739)	(0.138)	(0.101)
field_cultiv	3.727***	0.376***	0.148**
	(0.470)	(0.0952)	(0.0708)
large_livestock	-1.784***	0.00263	0.168***
	(0.418)	(0.0853)	(0.0628)
medium_livestock	-0.940*	-0.163*	0.0837
	(0.495)	(0.0918)	(0.0764)
small_livestock	3.566***	0.255***	0.0718
	(0.474)	(0.0954)	(0.0700)
lack_transp	-1.113*	0.448***	-0.108
	(0.626)	(0.136)	(0.0755)
poor_road	-1.186**	0.290**	-0.277***
	(0.538)	(0.120)	(0.0717)
area	-6.772***	-0.334***	-0.104
	(0.462)	(0.0945)	(0.0651)
DIV_CODE	-0.0728	-0.0267	-0.0345*
	(0.124)	(0.0261)	(0.0176)
food_aid	-0.00273	-0.0159*	0.00892
	(0.0796)	(0.00867)	(0.00802)
Constant cut1		-5.647***	-3.686***
		(0.466)	(0.355)
Constant cut2		-2.738***	-2.714***
		(0.437)	(0.342)
Constant cut3		4.479***	-0.250
		(0.438)	(0.334)
Constant cut4		5.872***	0.866***
		(0.444)	(0.334)
Constant cut5		7.453***	1.954***
		(0.503)	(0.337)
Constant cut6		9.160***	2.918***
		(0.832)	(0.339)
Constant	40.82***		
	(2.093)		
Observations	9,996	9,996	4,312
R-squared	0.218		

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1
OL: Ordered Logistics
N. of meals -Adults indicates the number of meals eaten by adult member 1d before the interview
N. of meals -Children indicates the number of meals eaten by children 1d before the interview

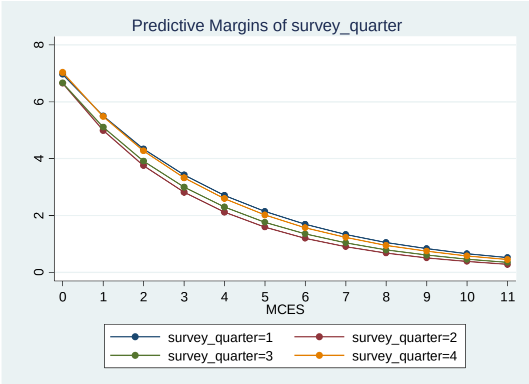
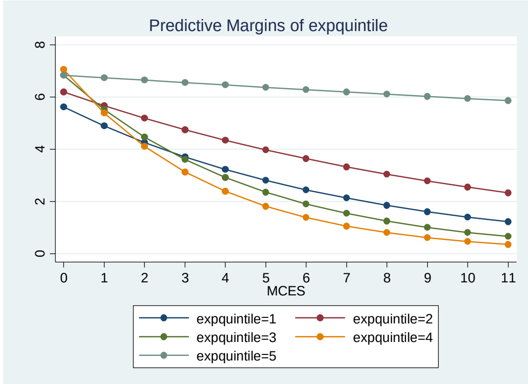
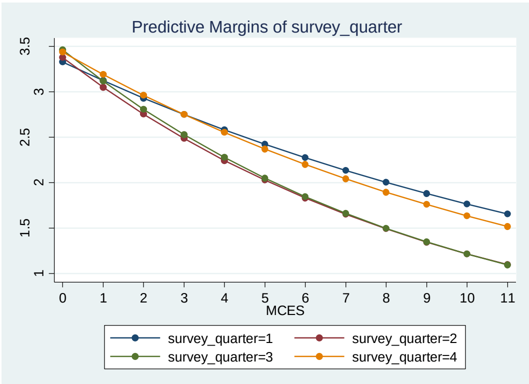
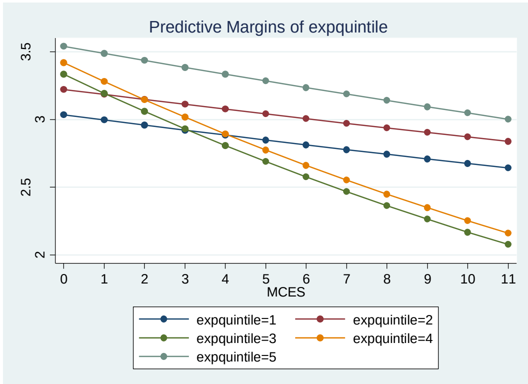
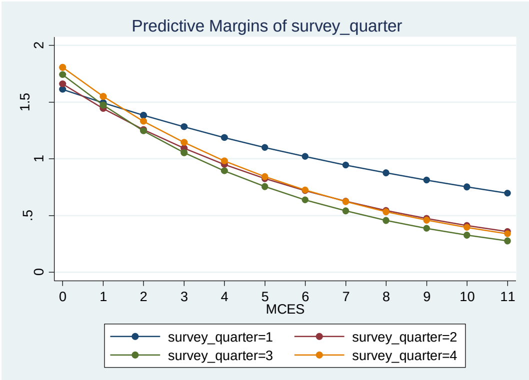
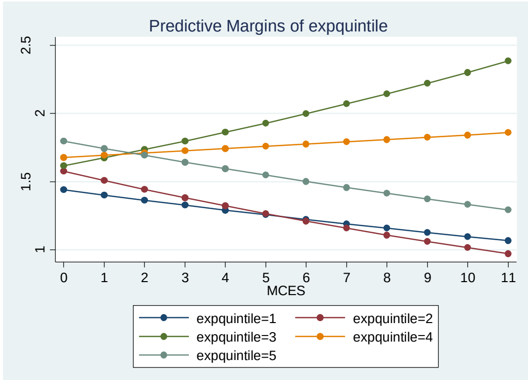
Table G 4 Regression results – MCES and Child Antropometrics – Bangladesh

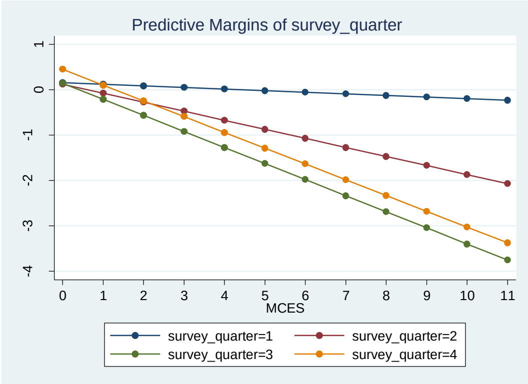
	OLS	OLS	OLS
VARIABLES	WHZ_CHILD	HAZ_CHILD	MUAC_Mother
MCES_new	0.112**	-0.392***	-3.865***
	-0.0577	-0.077	-1.409
dal_low_price	-0.00600***	0.0102***	0.131***
	(0.00150)	(0.00183)	(0.0351)
edible_oil_price	-0.0151***	0.0104***	0.100***
	(0.00125)	(0.00155)	(0.0287)
hhsize	0.0175**	0.0703***	-1.016***
	(0.00751)	(0.0101)	(0.233)
Sex	-0.745***	0.214***	19.11***
	(0.0525)	(0.0695)	(1.429)
Age	0.00656***	-0.00958***	
	(0.00157)	(0.00197)	
Educ	0.355***	-0.592***	
	(0.0346)	(0.0467)	
dependency_ratio	0.265***	0.221***	-2.467***
	(0.0305)	(0.0374)	(0.680)
age_group	-0.134***	-0.589***	
	(0.0191)	(0.0236)	
child_sex	-0.0425	0.0601	
	(0.0328)	(0.0424)	
BO	0.533***	-0.313***	
	(0.0466)	(0.0542)	
Milk_yest	-0.250***	-1.285***	2.903***
	(0.0453)	(0.0630)	(1.057)
vitamin_A	-0.0327	0.422***	
	(0.0460)	(0.0522)	
oedema	0.00348	-0.138	
	(0.262)	(0.288)	
large_livestock	0.196***	0.130**	-0.412
	(0.0421)	(0.0530)	(0.912)
medium_livestock	0.327***	-0.253***	-5.070***
	(0.0518)	(0.0586)	(1.045)
small_livestock	-0.338***	-0.195***	4.123***
	(0.0418)	(0.0520)	(0.915)
toilet	0.634**	2.267***	-3.886
	(0.260)	(0.312)	(7.040)
safe_water	-1.007***	-2.428***	-4.118***
	(0.0705)	(0.126)	(1.535)
empl_status	0.172***	0.638***	3.780***
	(0.0437)	(0.0608)	(1.029)
area	0.0683	0.144***	-9.662***
	(0.0449)	(0.0523)	(1.015)
DIV_CODE	0.00104	-0.113***	0.103
	(0.0117)	(0.0136)	(0.268)
food_aid	-0.0377***	-0.0201***	-1.130***
	(0.00757)	(0.00750)	(0.245)
Constant	1.140***	-0.188	211.7***
	(0.340)	(0.410)	(8.609)
Observations	7,318	7,458	6,738
R-squared	0.319	0.410	0.253
Robust standard errors in parentheses			
*** p<0.01, ** p<0.05, * p<0.1			

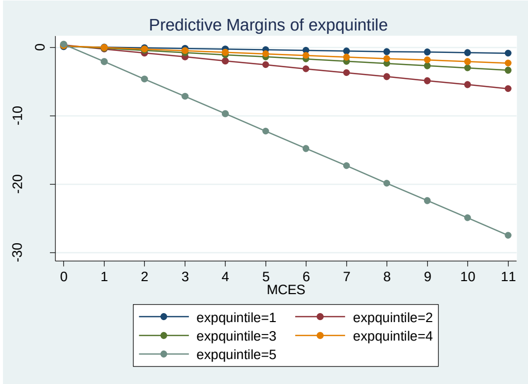
Appendix H Marginal effect graphs and diagnostics

Mozambique

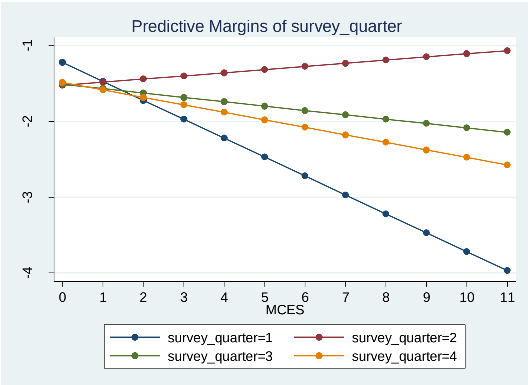
Marginal Effect Graphs – MCES and Food and nutrition security indicators. Association over survey quarter and expenditure quintile.

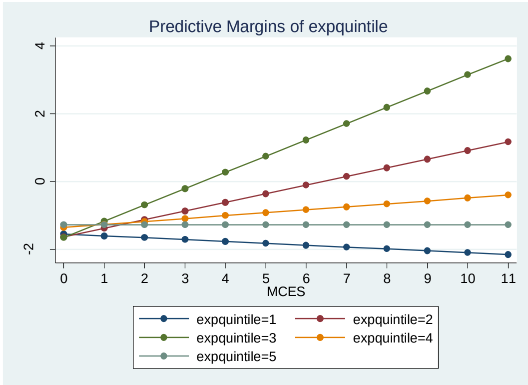
Survey Quarter	**Expenditure quintiles**
HDDS	
	
SAFI1-Meals Number	
	
SAFI2- Food Sufficiency	
	
Child Wasting (byWHZ)	





Child Stunting (by HAZ)





Legend:

HDDS: Household dietary diversity score with values that range between 0 to 12

Number of Meals: refers to adults meals frequency in the household (0-3)

Food sufficiency: answers to the question:During the past month the food in the household was: insufficient, sufficient, more than sufficient. Ranges from 1 to 3.

Child wasting (by whz): refers to acute malnutrition among children under 5 year of age, calculated with weight-for-height z-score.

Child stunting (by haz): refers to chronic malnutrition among children under 5 year of age, calculated with height-for-age z-score.

Marginal Effects Diagnostics

1) MCES and HDDS over survey quarter

```
. margins r.survey_quarter

Contrasts of predictive margins
Model VCE    : Robust

Expression   : Predicted number of events, predict()
```

	df	chi2	P>chi2
survey_quarter			
(2 vs 1)	1	63.80	0.0000
(3 vs 1)	1	48.11	0.0000
(4 vs 1)	1	0.23	0.6313
Joint	3	126.36	0.0000

	Contrast	Delta-method Std. Err.	[95% Conf.	Interval]
survey_quarter				
(2 vs 1)	-.4021838	.0503535	-.500875	-.3034927
(3 vs 1)	-.3476057	.0501142	-.4458276	-.2493838
(4 vs 1)	.0239119	.0498289	-.0737509	.1215746

```
. margins, dydx(survey_quarter)

Average marginal effects                        Number of obs     =     10,136
Model VCE    : Robust

Expression   : Predicted number of events, predict()
dy/dx w.r.t. : 2.survey_quarter 3.survey_quarter 4.survey_quarter
```

	dy/dx	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
survey_quarter						
2	-.4021838	.0503535	-7.99	0.000	-.500875	-.3034927
3	-.3476057	.0501142	-6.94	0.000	-.4458276	-.2493838
4	.0239119	.0498289	0.48	0.631	-.0737509	.1215746

Note: dy/dx for factor levels is the discrete change from the base level.

2) MCES and HDDS over expenditure quintiles

```
. margins r.expquintile

Contrasts of predictive margins
Model VCE    : Robust

Expression   : Predicted number of events, predict()
```

	df	chi2	P>chi2
expquintile			
(2 vs 1)	1	125.83	0.0000
(3 vs 1)	1	244.17	0.0000
(4 vs 1)	1	201.28	0.0000
(5 vs 1)	1	86.06	0.0000
Joint	4	308.61	0.0000

	Contrast	Delta-method Std. Err.	[95% Conf.	Interval]
expquintile				
(2 vs 1)	.6608009	.058909	.5453414	.7762603
(3 vs 1)	.9611152	.0615071	.8405634	1.081667
(4 vs 1)	1.021541	.0720031	.8804176	1.162665
(5 vs 1)	1.481099	.1596574	1.168176	1.794021

```
. margins, dydx(expquintile)

Average marginal effects                        Number of obs     =     10,136
Model VCE    : Robust

Expression   : Predicted number of events, predict()
dy/dx w.r.t. : 2.expquintile 3.expquintile 4.expquintile 5.expquintile
```

	dy/dx	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
expquintile						
2	.6608009	.058909	11.22	0.000	.5453414	.7762603
3	.9611152	.0615071	15.63	0.000	.8405634	1.081667
4	1.021541	.0720031	14.19	0.000	.8804176	1.162665
5	1.481099	.1596574	9.28	0.000	1.168176	1.794021

Note: dy/dx for factor levels is the discrete change from the base level.

3) MCES and Meals Number over survey quarter

```
. margins r.survey_quarter

Contrasts of predictive margins
Model VCE    : Robust

Expression   : Predicted number of events, predict()
```

	df	chi2	P>chi2
survey_quarter			
(2 vs 1)	1	0.04	0.8490
(3 vs 1)	1	16.53	0.0000
(4 vs 1)	1	24.80	0.0000
Joint	3	44.64	0.0000

	Contrast	Delta-method Std. Err.	[95% Conf.	Interval]
survey_quarter				
(2 vs 1)	-.0035319	.0185491	-.0398876	.0328237
(3 vs 1)	.0733557	.018042	.0379941	.1087173
(4 vs 1)	.0916701	.018408	.055591	.1277491

```
. margins, dydx(survey_quarter)

Average marginal effects                        Number of obs     =     10,168
Model VCE    : Robust

Expression   : Predicted number of events, predict()
dy/dx w.r.t. : 2.survey_quarter 3.survey_quarter 4.survey_quarter
```

	dy/dx	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
survey_quarter						
2	-.0035319	.0185491	-0.19	0.849	-.0398876	.0328237
3	.0733557	.018042	4.07	0.000	.0379941	.1087173
4	.0916701	.018408	4.98	0.000	.055591	.1277491

Note: dy/dx for factor levels is the discrete change from the base level.

4) MCES and Meals Number over expenditure quintiles

```
. margins r.expquintile

Contrasts of predictive margins
Model VCE    : Robust

Expression   : Predicted number of events, predict()
```

	df	chi2	P>chi2
expquintile			
(2 vs 1)	1	68.82	0.0000
(3 vs 1)	1	115.49	0.0000
(4 vs 1)	1	142.76	0.0000
(5 vs 1)	1	92.34	0.0000
Joint	4	203.35	0.0000

	Contrast	Delta-method Std. Err.	[95% Conf.	Interval]
expquintile				
(2 vs 1)	.1876796	.0226231	.1433392	.23202
(3 vs 1)	.2563944	.0238583	.209633	.3031559
(4 vs 1)	.3419761	.0286217	.2858787	.3980735
(5 vs 1)	.4993206	.0519628	.3974753	.6011659

```
. margins, dydx(expquintile)

Average marginal effects                        Number of obs     =     10,168
Model VCE    : Robust

Expression   : Predicted number of events, predict()
dy/dx w.r.t. : 2.expquintile 3.expquintile 4.expquintile 5.expquintile
```

	dy/dx	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
expquintile						
2	.1876796	.0226231	8.30	0.000	.1433392	.23202
3	.2563944	.0238583	10.75	0.000	.209633	.3031559
4	.3419761	.0286217	11.95	0.000	.2858787	.3980735
5	.4993206	.0519628	9.61	0.000	.3974753	.6011659

Note: dy/dx for factor levels is the discrete change from the base level.

5) MCES and Food sufficiency over survey quarter

```
. margins r.survey_quarter

Contrasts of predictive margins
Model VCE    : Robust

Expression   : Predicted number of events, predict()
```

	df	chi2	P>chi2
survey_quarter			
(2 vs 1)	1	0.18	0.6742
(3 vs 1)	1	20.94	0.0000
(4 vs 1)	1	87.73	0.0000
Joint	3	118.55	0.0000

	Contrast	Delta-method Std. Err.	[95% Conf.	Interval]
survey_quarter				
(2 vs 1)	.0060611	.01442	-.0222015	.0343237
(3 vs 1)	.0666238	.0145576	.0380914	.0951562
(4 vs 1)	.1354044	.0144565	.1070702	.1637385

```
. margins, dydx(survey_quarter)

Average marginal effects                        Number of obs     =     10,144
Model VCE    : Robust

Expression   : Predicted number of events, predict()
dy/dx w.r.t. : 2.survey_quarter 3.survey_quarter 4.survey_quarter
```

	dy/dx	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
survey_quarter						
2	.0060611	.01442	0.42	0.674	-.0222015	.0343237
3	.0666238	.0145576	4.58	0.000	.0380914	.0951562
4	.1354044	.0144565	9.37	0.000	.1070702	.1637385

Note: dy/dx for factor levels is the discrete change from the base level.

6) MCES and Food sufficiency over expenditure quintiles

```
. margins r.expquintile

Contrasts of predictive margins
Model VCE    : Robust

Expression   : Predicted number of events, predict()
```

	df	chi2	P>chi2
expquintile			
(2 vs 1)	1	43.09	0.0000
(3 vs 1)	1	125.18	0.0000
(4 vs 1)	1	133.53	0.0000
(5 vs 1)	1	85.03	0.0000
Joint	4	200.31	0.0000

	Contrast	Delta-method Std. Err.	[95% Conf.	Interval]
expquintile				
(2 vs 1)	.1239578	.0188833	.0869472	.1609683
(3 vs 1)	.2171679	.0194101	.1791248	.2552109
(4 vs 1)	.2611567	.0226002	.216861	.3054524
(5 vs 1)	.3507314	.0380365	.2761812	.4252816

```
. margins, dydx(expquintile)

Average marginal effects                        Number of obs     =     10,144
Model VCE    : Robust

Expression   : Predicted number of events, predict()
dy/dx w.r.t. : 2.expquintile 3.expquintile 4.expquintile 5.expquintile
```

	dy/dx	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
expquintile						
2	.1239578	.0188833	6.56	0.000	.0869472	.1609683
3	.2171679	.0194101	11.19	0.000	.1791248	.2552109
4	.2611567	.0226002	11.56	0.000	.216861	.3054524
5	.3507314	.0380365	9.22	0.000	.2761812	.4252816

Note: dy/dx for factor levels is the discrete change from the base level.

7) MCES and child wasting (by whz) over survey quarter

```
. marginsplot, noci

  Variables that uniquely identify margins: MCES survey_quarter

. margins r.survey_quarter

Contrasts of predictive margins
Model VCE    : Robust

Expression   : Linear prediction, predict()
```

	df	F	P>F
survey_quarter			
(2 vs 1)	1	1.77	0.1835
(3 vs 1)	1	3.49	0.0617
(4 vs 1)	1	2.99	0.0839
Joint	3	6.17	0.0004
Denominator	4012		

	Contrast	Delta-method Std. Err.	[95% Conf.	Interval]
survey_quarter				
(2 vs 1)	-.1014758	.0762728	-.2510129	.0480613
(3 vs 1)	-.1488431	.0796537	-.3050087	.0073225
(4 vs 1)	.1598432	.0924548	-.0214197	.3411061

```
. margins, dydx(survey_quarter)

Average marginal effects                       Number of obs     =      4,042
Model VCE    : Robust

Expression   : Linear prediction, predict()
dy/dx w.r.t. : 2.survey_quarter 3.survey_quarter 4.survey_quarter
```

	dy/dx	Delta-method Std. Err.	t	P>|t|	[95% Conf.	Interval]
survey_quarter						
2	-.1014758	.0762728	-1.33	0.183	-.2510129	.0480613
3	-.1488431	.0796537	-1.87	0.062	-.3050087	.0073225
4	.1598432	.0924548	1.73	0.084	-.0214197	.3411061

Note: dy/dx for factor levels is the discrete change from the base level.

8) MCES and child wasting (by whz) over expenditure quintile

```
. marginsplot, noci

  Variables that uniquely identify margins: MCES expquintile

. margins r.expquintile

Contrasts of predictive margins
Model VCE    : Robust

Expression   : Linear prediction, predict()
```

	df	F	P>F
expquintile			
(2 vs 1)	1	0.14	0.7068
(3 vs 1)	1	0.00	0.9723
(4 vs 1)	1	0.15	0.7008
(5 vs 1)	1	5.77	0.0163
Joint	4	1.65	0.1587
Denominator	4010		

	Contrast	Delta-method Std. Err.	[95% Conf.	Interval]
expquintile				
(2 vs 1)	.0299634	.0796425	-.1261801	.186107
(3 vs 1)	.0030719	.0883489	-.1701411	.1762848
(4 vs 1)	.0452849	.1178563	-.1857788	.2763487
(5 vs 1)	-.7177145	.2986802	-1.303294	-.1321355

```
. margins, dydx(expquintile)

Average marginal effects                    Number of obs     =      4,042
Model VCE    : Robust

Expression   : Linear prediction, predict()
dy/dx w.r.t. : 2.expquintile 3.expquintile 4.expquintile 5.expquintile
```

	dy/dx	Delta-method Std. Err.	t	P>|t|	[95% Conf.	Interval]
expquintile						
2	.0299634	.0796425	0.38	0.707	-.1261801	.186107
3	.0030719	.0883489	0.03	0.972	-.1701411	.1762848
4	.0452849	.1178563	0.38	0.701	-.1857788	.2763487
5	-.7177145	.2986802	-2.40	0.016	-1.303294	-.1321355

Note: dy/dx for factor levels is the discrete change from the base level.

9) MCES and child stunting (by haz) over survey quarter

```
. margins r.survey_quarter

Contrasts of predictive margins
Model VCE    : Robust

Expression   : Linear prediction, predict()

------------------------------------------------
               |         df           F        P>F
---------------+--------------------------------
survey_quarter |
     (2 vs 1)  |          1        3.83     0.0503
     (3 vs 1)  |          1        5.33     0.0210
     (4 vs 1)  |          1        3.71     0.0541
        Joint  |          3        2.49     0.0584
               |
   Denominator |       4035
------------------------------------------------

----------------------------------------------------------------
               |            Delta-method
               |   Contrast   Std. Err.     [95% Conf. Interval]
---------------+------------------------------------------------
survey_quarter |
     (2 vs 1)  |  -.1769158   .0903653     -.3540817    .0002502
     (3 vs 1)  |  -.2051237   .0888562      -.379331   -.0309165
     (4 vs 1)  |  -.1974944   .1025279     -.3985058    .0035169
----------------------------------------------------------------

. margins, dydx(survey_quarter)

Average marginal effects                        Number of obs     =      4,065
Model VCE    : Robust

Expression   : Linear prediction, predict()
dy/dx w.r.t. : 2.survey_quarter 3.survey_quarter 4.survey_quarter

-------------------------------------------------------------------------------
               |            Delta-method
               |      dy/dx   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------+---------------------------------------------------------------
survey_quarter |
             2 |  -.1769158   .0903653    -1.96   0.050    -.3540817    .0002502
             3 |  -.2051237   .0888562    -2.31   0.021     -.379331   -.0309165
             4 |  -.1974944   .1025279    -1.93   0.054    -.3985058    .0035169
-------------------------------------------------------------------------------
Note: dy/dx for factor levels is the discrete change from the base level.
```

MCES and child stunting (by haz) over expenditure quintile

```
. marginsplot, noci

  Variables that uniquely identify margins: MCES expquintile

. margins r.expquintile

Contrasts of predictive margins
Model VCE    : Robust

Expression   : Linear prediction, predict()
```

	df	F	P>F
expquintile			
(2 vs 1)	1	0.29	0.5914
(3 vs 1)	1	1.54	0.2153
(4 vs 1)	1	2.83	0.0925
(5 vs 1)	1	0.79	0.3739
Joint	4	0.99	0.4137
Denominator	4033		

	Contrast	Delta-method Std. Err.	[95% Conf.	Interval]
expquintile				
(2 vs 1)	.0497797	.0927215	-.1320056	.231565
(3 vs 1)	.1290799	.1041644	-.0751398	.3332996
(4 vs 1)	.2576784	.1531505	-.0425811	.557938
(5 vs 1)	.2948374	.3315735	-.3552298	.9449045

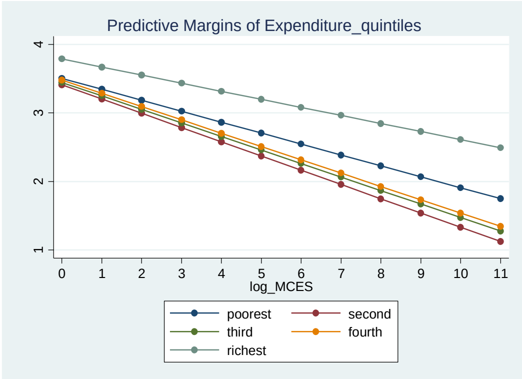
```
. margins, dydx(expquintile)

Average marginal effects                        Number of obs     =      4,065
Model VCE    : Robust

Expression   : Linear prediction, predict()
dy/dx w.r.t. : 2.expquintile 3.expquintile 4.expquintile 5.expquintile
```

	dy/dx	Delta-method Std. Err.	t	P>|t|	[95% Conf.	Interval]
expquintile						
2	.0497797	.0927215	0.54	0.591	-.1320056	.231565
3	.1290799	.1041644	1.24	0.215	-.0751398	.3332996
4	.2576784	.1531505	1.68	0.093	-.0425811	.557938
5	.2948374	.3315735	0.89	0.374	-.3552298	.9449045

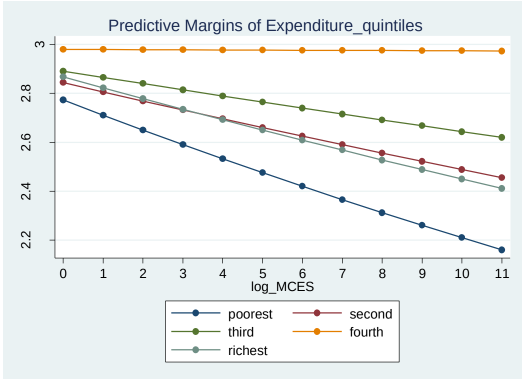
Note: dy/dx for factor levels is the discrete change from the base level.

Bangladesh

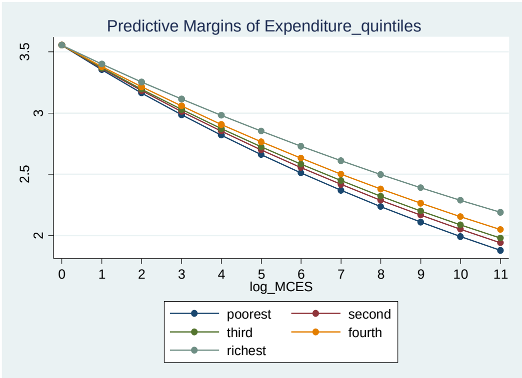
Food Consumption Scores



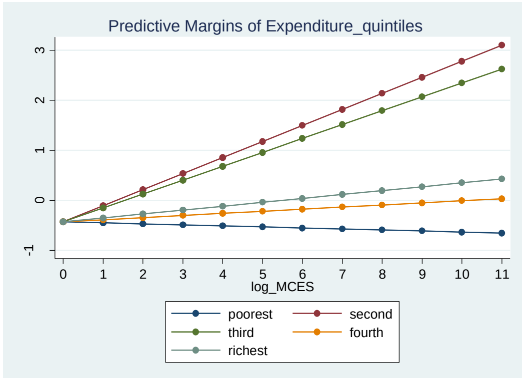
Adults Meals Number



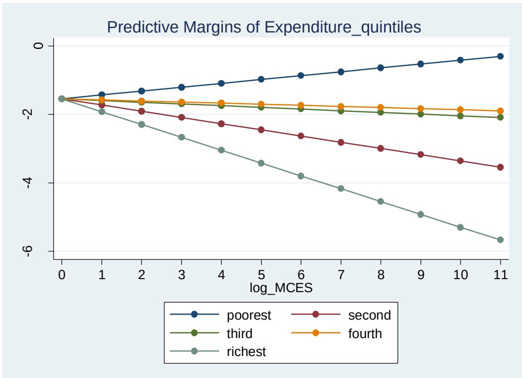
Children Meals Number



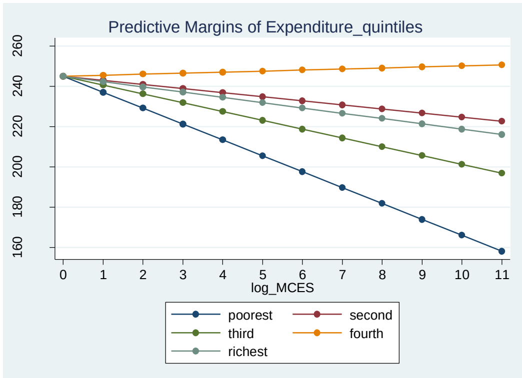
Child Wasting (by WHZ)



Child Stunting (by HAZ)



Maternal Wasting (by MUAC)



Marginal Effects Diagnostics

1) MCES and FCS over expenditure quintile

```
. margins r.Expenditure_quintiles

Contrasts of predictive margins
Model VCE    : Robust

Expression   : Linear prediction, predict()
```

	df	F	P>F
Expenditure_quintiles			
(second vs poorest)	1	77.12	0.0000
(third vs poorest)	1	134.94	0.0000
(fourth vs poorest)	1	122.12	0.0000
(richest vs poorest)	1	43.32	0.0000
Joint	4	43.95	0.0000
Denominator	9967		

	Contrast	Delta-method Std. Err.	[95% Conf.	Interval]
Expenditure_quintiles				
(second vs poorest)	5.174983	.5892736	4.019887	6.330078
(third vs poorest)	7.126086	.6134613	5.923578	8.328594
(fourth vs poorest)	9.390138	.8497229	7.724509	11.05577
(richest vs poorest)	9.97854	1.516086	7.006705	12.95038

```
. margins, dydx(Expenditure_quintiles)

Average marginal effects                        Number of obs     =      9,996
Model VCE    : Robust

Expression   : Linear prediction, predict()
dy/dx w.r.t. : 2.Expenditure_quintiles 3.Expenditure_quintiles 4.Expenditure_quintiles
               5.Expenditure_quintiles
```

	dy/dx	Delta-method Std. Err.	t	P>|t|	[95% Conf.	Interval]
Expenditure_quintiles						
second	5.174983	.5892736	8.78	0.000	4.019887	6.330078
third	7.126086	.6134613	11.62	0.000	5.923578	8.328594
fourth	9.390138	.8497229	11.05	0.000	7.724509	11.05577
richest	9.97854	1.516086	6.58	0.000	7.006705	12.95038

Note: dy/dx for factor levels is the discrete change from the base level.

3) MCES and Meals number (adults) over expenditure quintile

```
. margins r.Expenditure_quintiles

Contrasts of predictive margins
Model VCE    : Robust

Expression   : Predicted number of events, predict()
```

	df	chi2	P>chi2
Expenditure_quintiles			
(second vs poorest)	1	6.60	0.0102
(third vs poorest)	1	10.22	0.0014
(fourth vs poorest)	1	10.90	0.0010
(richest vs poorest)	1	3.37	0.0666
Joint	4	12.96	0.0115

	Contrast	Delta-method Std. Err.	[95% Conf.	Interval]
Expenditure_quintiles				
(second vs poorest)	.0341536	.0132978	.0080903	.0602168
(third vs poorest)	.0476207	.0148941	.0184288	.0768127
(fourth vs poorest)	.0654992	.0198424	.0266088	.1043895
(richest vs poorest)	.0477024	.0260029	-.0032624	.0986672

```
. margins, dydx(Expenditure_quintiles)

Average marginal effects                        Number of obs     =      9,996
Model VCE    : Robust

Expression   : Predicted number of events, predict()
dy/dx w.r.t. : 2.Expenditure_quintiles 3.Expenditure_quintiles 4.Expenditure_quintiles
               5.Expenditure_quintiles
```

	dy/dx	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
Expenditure_quintiles						
second	.0341536	.0132978	2.57	0.010	.0080903	.0602168
third	.0476207	.0148941	3.20	0.001	.0184288	.0768127
fourth	.0654992	.0198424	3.30	0.001	.0266088	.1043895
richest	.0477024	.0260029	1.83	0.067	-.0032624	.0986672

MCES and Meals number (children) over expenditure quintile

```
. margins r.Expenditure_quintiles

Contrasts of predictive margins
Model VCE    : Robust

Expression   : Predicted number of events, predict()
```

	df	chi2	P>chi2
Expenditure_quintiles			
(second vs poorest)	1	3.28	0.0700
(third vs poorest)	1	0.78	0.3760
(fourth vs poorest)	1	2.16	0.1413
(richest vs poorest)	1	5.89	0.0152
Joint	4	7.20	0.1257

	Contrast	Delta-method Std. Err.	[95% Conf.	Interval]
Expenditure_quintiles				
(second vs poorest)	-.0919655	.0507551	-.1914437	.0075127
(third vs poorest)	-.0698872	.0789432	-.2246131	.0848387
(fourth vs poorest)	-.1581629	.1075261	-.3689103	.0525845
(richest vs poorest)	-.4467127	.1841028	-.8075477	-.0858778

```
. margins, dydx(Expenditure_quintiles)

Average marginal effects                        Number of obs     =      4,312
Model VCE    : Robust

Expression   : Predicted number of events, predict()
dy/dx w.r.t. : 2.Expenditure_quintiles 3.Expenditure_quintiles 4.Expenditure_quintiles
               5.Expenditure_quintiles
```

	dy/dx	Delta-method Std. Err.	z	P>|z|	[95% Conf.	Interval]
Expenditure_quintiles						
second	-.0919655	.0507551	-1.81	0.070	-.1914437	.0075127
third	-.0698872	.0789432	-0.89	0.376	-.2246131	.0848387
fourth	-.1581629	.1075261	-1.47	0.141	-.3689103	.0525845
richest	-.4467127	.1841028	-2.43	0.015	-.8075477	-.0858778

Note: dy/dx for factor levels is the discrete change from the base level.

MCES and child wasting (by whz) over expenditure quintile

```
. margins r.Expenditure_quintiles

Contrasts of predictive margins
Model VCE    : Robust

Expression   : Linear prediction, predict()
```

	df	F	P>F
Expenditure_quintiles			
(second vs poorest)	1	0.58	0.4467
(third vs poorest)	1	6.63	0.0101
(fourth vs poorest)	1	5.84	0.0157
(richest vs poorest)	1	1.23	0.2672
Joint	4	3.64	0.0057
Denominator	7429		

	Contrast	Delta-method Std. Err.	[95% Conf.	Interval]
Expenditure_quintiles				
(second vs poorest)	-.0700385	.0920356	-.2504543	.1103772
(third vs poorest)	-.2669805	.1037002	-.4702622	-.0636988
(fourth vs poorest)	-.7554977	.3126745	-1.368428	-.142567
(richest vs poorest)	.4165136	.3753862	-.3193498	1.152377

```
. margins, dydx(Expenditure_quintiles)

Average marginal effects                    Number of obs     =      7,461
Model VCE    : Robust

Expression   : Linear prediction, predict()
dy/dx w.r.t. : 2.Expenditure_quintiles 3.Expenditure_quintiles 4.Expenditure_quintiles
               5.Expenditure_quintiles
```

	dy/dx	Delta-method Std. Err.	t	P>|t|	[95% Conf.	Interval]
Expenditure_quintiles						
second	-.0700385	.0920356	-0.76	0.447	-.2504543	.1103772
third	-.2669805	.1037002	-2.57	0.010	-.4702622	-.0636988
fourth	-.7554977	.3126745	-2.42	0.016	-1.368428	-.142567
richest	.4165136	.3753862	1.11	0.267	-.3193498	1.152377

Note: dy/dx for factor levels is the discrete change from the base level.

MCES and child Stunting (by haz) over expenditure quintile

```
. margins r.Expenditure_quintiles

Contrasts of predictive margins
Model VCE    : Robust

Expression   : Linear prediction, predict()
```

	df	F	P>F
Expenditure_quintiles			
(second vs poorest)	1	34.61	0.0000
(third vs poorest)	1	0.88	0.3473
(fourth vs poorest)	1	0.14	0.7079
(richest vs poorest)	1	64.62	0.0000
Joint	4	37.31	0.0000
Denominator	7433		

	Contrast	Delta-method Std. Err.	[95% Conf.	Interval]
Expenditure_quintiles				
(second vs poorest)	.3564828	.060595	.2376995	.4752662
(third vs poorest)	.0811851	.0863742	-.0881328	.2505031
(fourth vs poorest)	.055848	.1490527	-.2363375	.3480336
(richest vs poorest)	2.154366	.2680054	1.629	2.679733

```
. margins, dydx(Expenditure_quintiles)

Average marginal effects                        Number of obs     =      7,461
Model VCE    : Robust

Expression   : Linear prediction, predict()
dy/dx w.r.t. : 2.Expenditure_quintiles 3.Expenditure_quintiles 4.Expenditure_quintiles
               5.Expenditure_quintiles
```

	dy/dx	Delta-method Std. Err.	t	P>|t|	[95% Conf.	Interval]
Expenditure_quintiles						
second	.3564828	.060595	5.88	0.000	.2376995	.4752662
third	.0811851	.0863742	0.94	0.347	-.0881328	.2505031
fourth	.055848	.1490527	0.37	0.708	-.2363375	.3480336
richest	2.154366	.2680054	8.04	0.000	1.629	2.679733

Note: dy/dx for factor levels is the discrete change from the base level.

MCES and maternal wasting (by muac) over expenditure quintile

```
. margins r.Expenditure_quintiles

Contrasts of predictive margins
Model VCE    : Robust

Expression   : Linear prediction, predict()

------------------------------------------------------
                      |         df        F        P>F
----------------------+-------------------------------
Expenditure_quintiles |
 (second vs poorest)  |          1    10.08     0.0015
  (third vs poorest)  |          1     0.11     0.7445
 (fourth vs poorest)  |          1    13.91     0.0002
(richest vs poorest)  |          1     4.80     0.0285
               Joint  |          4    16.06     0.0000
                      |
         Denominator  |       6707
------------------------------------------------------

--------------------------------------------------------------------
                      |              Delta-method
                      |   Contrast   Std. Err.     [95% Conf. Interval]
----------------------+---------------------------------------------
Expenditure_quintiles |
 (second vs poorest)  |  -3.364925   1.059845     -5.442558   -1.287293
  (third vs poorest)  |   .6011501   1.844139     -3.013949    4.216249
 (fourth vs poorest)  |  -10.67346   2.862148     -16.28417   -5.062735
(richest vs poorest)  |   12.86819     5.8755      1.350342    24.38604
--------------------------------------------------------------------

. margins, dydx(Expenditure_quintiles)

Average marginal effects                        Number of obs     =      6,738
Model VCE    : Robust

Expression   : Linear prediction, predict()
dy/dx w.r.t. : 2.Expenditure_quintiles 3.Expenditure_quintiles 4.Expenditure_quintiles
               5.Expenditure_quintiles

-------------------------------------------------------------------------------------
                      |            Delta-method
                      |      dy/dx   Std. Err.      t    P>|t|     [95% Conf. Interval]
----------------------+--------------------------------------------------------------
Expenditure_quintiles |
               second |  -3.364925   1.059845    -3.17   0.002    -5.442558   -1.287293
                third |   .6011501   1.844139     0.33   0.744    -3.013949    4.216249
               fourth |  -10.67346   2.862148    -3.73   0.000    -16.28417   -5.062735
              richest |   12.86819     5.8755     2.19   0.029     1.350342    24.38604
-------------------------------------------------------------------------------------
Note: dy/dx for factor levels is the discrete change from the base level.
```

Appendix I Methods and data used to develop the MCES at higher aggregation levels

Introduction

As mentioned in Chapter 2, the methodology of the MCES allows the calculation of the indicator at different aggregation levels. This characteristic offers opportunities as well as challenges. It represents a significant methodological improvement for monitoring the effects of food price fluctuations on food and nutrition security at the macro level, complementing individual food prices that are crucial for the wellbeing of vulnerable populations in low-income countries. However, as the aggregation level increase, the nutritional value of the indicator declines, limiting the interpretative power on the extent and nature of nutritional impacts of food price fluctuations.

This chapter presents the expanded methods and data sources for the computation of the indicator at the country level (6.1) followed by an overview of some preliminary results and discussion (6.2). Section 6.4 concludes the chapter, addressing the crucial theme of data quality and limitations.

Country level MCES: Methods and estimates

Following previous work by Dorward (2013), the calculation of the MCES at the national level allows the computation of the indicator using data from national accounts. For example, the MCES can be calculated for two specific expenditure fractiles of a population: the *MCES_D1* for the first expenditure decile and *MCES_Q3* for middle expenditure quintile of the population, which approximate the lowest and median expenditure groups of the population. Calculating the MCES for these two groups allows the comparison of the MCES results between income groups (one poor and the other one middle-income) and to appreciate the differential effects of food price rises on different segments of the population.

The estimation is developed in two blocks: one for the price element (the numerator) and one for the total per capita expenditure element (the denominator). The national level MCES is calculated at annual per capita level, a choice driven from the fact that data on national consumption expenditure are estimated at annual intervals in *per capita* terms. Similarly to the MCES at the Household level the MCES at the country level is specified as follows:

Equation I.1

A **B**

$$\boldsymbol{MCES\_D1} = \frac{\sum_{i=1}^{n}(\frac{P_i w_i}{K_i}) MinKcal_{staples}) * 365}{PcExp_{D1}} \quad \text{and} \quad \boldsymbol{MCES\_Q3} = \frac{\sum_{i=1}^{n}(\frac{P_i w_i}{K_i}) MinKcal_{staples}) * 365}{PcExp_{Q3}}$$

Where

- *MCES_D1* and *MCES_Q3* are the MCES calculated for the first expenditure decile and third (expenditure) quintile of the population;
- P_i denotes the annual average retail domestic price(domestic currency per Kg) for each staple food item*i* to *n;*
- w_i is the country specific share of calories for each staple food item*i* in the total staples basket;
- k_i represents the calorie density per Kgof each staple food item*i;*
- $MinKcal_{staples}$ reflects the percentage of dietary energy supply (DES) from staple foods over the minimum standard daily calorie requirement (2100 kcal a day per capita ((FAO, WHO, and UNU 2001))[1];
- $PcExp_{D1}$ and $PcExp_{Q3}$ reflect (respectively) the per capita expenditure of the first expenditure decile and third expenditure quintile of the population.

This thesis mainly uses FAO-GIEWS Food Price Data and Analysis Tool to retrieve price data[2]. The database includes both retail and wholesale monthly basic food prices[3]. *Weights (w_i)* are extracted from the FAOSTAT Food Balance Sheets using annual figures (subject to the most recent available data on the database)[4]. Data to calculate k_i are retrieved from country specific FCT.

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[1]For example, if the percentage of DES from staple foods is 70%, MinKcal_staples is: 2100*0.70= 1470.
[2]http://www.fao.org/giews/food-prices/tool/public/#/dataset/domestic
[3]Although the database includes a large number of countries, markets and time periods, domestic food prices in several countries pertinent to the analysis are not available for the time period needed for the construction of the MCES. The database also misses prices for some staple foods (particularly roots and tubers) that are important for dietary staples for poorer population in Sub-Saharan African countries.
[4] Fao Food Balance Sheet, using information on Food Supply (Kcal/capita/year) http://www.fao.org/faostat/en/#data/FBS.

The denominator of the MCES, namely the national ***Per capita expenditure*** is computed in two steps: (i) estimation of deciles and quintile consumption expenditure shares and (ii) estimation of mean consumption per capita for the first expenditure decile (D1) and third expenditure quintile (Q3) from the national expenditure distribution.

The decile consumption expenditure shares of the two expenditure groups(*D1share* and *Q3share*) are obtained from PovcalNet[5], an interactive computational tool developed by the Development Research Group of the World Bank that replicates calculations on absolute poverty in the world. Parametric Lorenz Curves are used for the estimation of the expenditure shares for each expenditure group.

Lastly, the*Total per capita expenditure*is calculated for both expenditure groups by multiplying the estimates of the first decile expenditure share (*D1share*) and third quintile expenditure share (*Q3share*) by the household final consumption expenditure (*HH expenditure*), in order to obtain the estimate of the total consumption of each group. Data on household final consumption expenditure is extracted from the World Development Indicators (WDI) database[6]. Data expressed in current US Dollars is converted into local currencies. Exchange rates are obtained from IFS, one of the main statistical publications of the International Monetary Fund (IMF) that collects and publishes monthly exchange rates of a wide range of currencies.

The mean total per capita expenditure of the decile and mid-quintile are then calculated by dividing the total consumption of each group by the population for each group, equal to 10 percent and 20 percent of total population[7] for the first decile and third quintilerespectively. The overall calculation of per capita consumption expenditure in each expenditure group is defined as:

---

[5] http://iresearch.worldbank.org/PovcalNet/index.htm

[6] National account for household final consumption expenditure is retrieved from the World Development Indicators (WDI) database under the following code: NE.CON.PRVT.CD.

[7] This information is gathered from the World Development Indicators (WDI) database under the following code: SP.POP.TOTL

Equation I.2

A

$$\boldsymbol{PcExp_{D1}} = \frac{D1share * HH\ expenditure}{10\%\ Total\ Population}$$

and

B

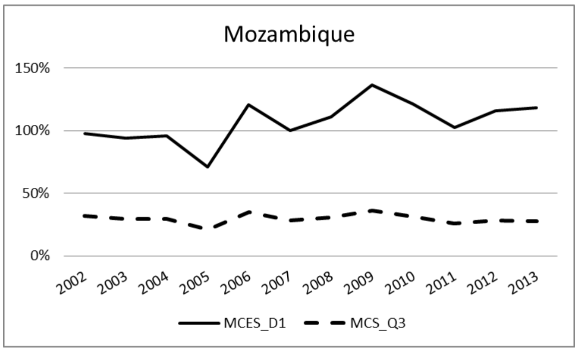
$$\boldsymbol{PcExp_{Q3}} = \frac{Q3share * HH\ expenditure}{20\%\ Total\ Population}$$

Results and discussion

Error! Reference source not found.I.1 illustrates the MCES calculated with national level data for Mozambique and Bangladesh, the two case studies discussed in the micro-validation.

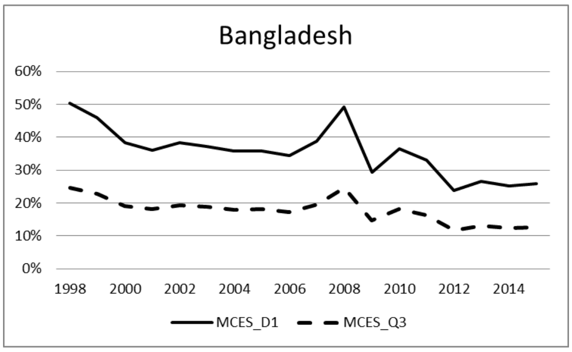
Figure I.1 Country level MCES – Preliminary estimates from Mozambique and Bangladesh

A



Includes: monthly retail maize and rice prices (Meticais/Tonne) for Angonia, Chokwe, Gorongosa, Manica, Maputo, Maxixe, Milange, Montepuez, Nampula, Ribaue. Monthly cassava prices only for Nampula.
Source: Author

B



Includes: Average retail rice prices (Taka/tonnes) for Dhaka.

The two graphs provide the annual trend of the MCES for the first expenditure quintile (MCES_D1) and the third expenditure quintile (MCES_Q3), from early 2000s for Mozambique and 1998 for Bangladesh. Using the national account data provides similar trends found with data at the household level. Values of the MCES for lower income households are significantly higher than MCES values for better-off households. The two food crises of 2008-09 and 2010-11 are well marked but they have impacted the two expenditure groups in different ways.

The MCES calculated for Mozambique includes domestic prices of maize, cassava and rice. The values of the MCES_D1 show that between 2002 and 2013 poorer households required between 73% to 121% of their consumption expenditure to purchase a portion of their daily energy requirement from staple foods calories. To purchase the same amount of calories (from the same bundle of crops) constituted between 20% and 35% of the expenditure of middle-income population, a value which is relatively high. Two peaks are visible in the chart that refer to the 2005 and 2007-2008 food price crises, the first one depicting a national food crisis, while the second coincides with the well-known global food price crisis. In 2004/05 cereal production declined by 4% compared to the previous season, mainly due to a 43% drop in output in the southern regions. Due to this crop failure 800 000 people were left food insecure and in dire need of food aid at the end of 2005 (OECD 2006).

The MCES computed for Bangladesh includes average prices of rice quoted in Dhaka (Taka/kg) and panel B illustrates the trends of the MCES from 1998 to 2015. The values of the MCES_D1 show that poorer households required between 25% to 50% of their consumption expenditure to purchase a portion of the daily energy requirement from staple foods calories, compared to 10% and 25% of wealthier households. The figures reflect the same differences of the MCES between the two countries using household budget surveys. The highest value of the MCES corresponds to the 2008 food crisis.

While Bangladesh shows a gradual improvement in terms of staple foods affordability over time (with the exception of the two food price crises), values of the MCES for Mozambique vary within the same band and appear to be deteriorating for those with less resources. Between 1998 to 2015 rice prices in Bangladesh increases were outpaced by substantial household expenditure growth (25%[8] and 139%[9] respectively). Conversely, in Mozambique maize prices increased at a slightly higher rate than household expenditure of poorer households (120% and 107% respectively between 2002 and 2013). This is why MCES values in Mozambique fluctuate within the same band in the past eleven years.

As mentioned previously, the different aggregation levels of the MCES are an attractive characteristic that allows comparisons over different dimensions. However, the number of caveats increase with higher aggregation levels. First it is important to acknowledge that as the aggregation level increases the nutritional value and meaning of the MCES decreases. Secondly, the discussion on data quality and frequency becomes more important. These considerations change substantially the aim of the MCES, making it an index that can help signal early stages of food price shocks. The following sections illustrate the methods used to develop national level MCES, followed by a consideration of the limitations of the underlying data.

[8] http://www.fao.org/giews/food-prices/tool/public/#/dataset/domestic, accessed 05 Aug 2017.

[9] http://data.worldbank.org/indicator/NE.CON.PRVT.CD,accessed 05 Aug 2017.

7.3 Limitations of the MCES at higher aggregation levels

The following section concludes the chapter by reflecting on the experience of calculating the MCES at the country level. This exercise took place in the early stages of the research, exploring alternative methodological approaches then applied to the computation of the MCES at the household level. The following considerations reflect on the nature and quality of the data and databases used to compute the MCES at the country level.

The FAO-GIEWS Food Price Data and Analysis Tool includes commodity prices for a large number of low and middle income countries. However, various important states are missing, mainly due to conflicts, political unwillingness to share data and/or lack of capacity and resources in data collection.

Figure I.2 Geographic coverage of the FAO-GIEWS Food Price Data and Analysis Tool.

Prices are available for countries in grey.
Source: FAO-GIEWS Food Price Data and Analysis Tool – accessed 29 July 2017

The main issues with the price database are briefly summarized as follows:

- Different time lengths of price series, both between countries and between commodities, making cross country comparisons problematic. In addition, the vast majority of the series start after 2005, meaning that interpretation on historical trends are based on less than 10 years' worth of data.
- There is insufficient price coverage for a number of staple foods (particularly roots and tubers), important in the dietary pattern of various countries.
- The database offers both retail (58%) and wholesale (42%) prices. Some countries report both prices for each commodity but the vast majority only report one type. Nearly half of the staple food prices are wholesale/producer prices and are generally lower than the price consumers pay.
- Some countries have a large number of markets represented in the database while others rely on a small number of markets or on national averages. As a result, often only the average staple food prices of the capital is available.

Despite these issues, the database is a valuable and timely source of data, regularly updated at the monthly level and validated by commodity specialists sitting in ministries and the FAO. Monthly price data can allow the calculation of the MCES at the monthly level. However, there is no data on monthly Household Final Consumption Expenditure. Initial trials have calculated the MCES on a monthly basis, by assuming consumption expenditure is evenly spread throughout the year; a very unrealistic assumption and a main limitation of national level MCES. In addition to the periodicity of data on household consumption expenditure, there are major geographic differences in data quality and frequency. The bulk of the problem resides in the data quality and frequency of the consumption shares by deciles. Data on income distribution are drawn from nationally representative household surveys. They are conducted by various bodies such as national statistical offices, private agencies under the supervision of government, international agencies. The information is subsequently obtained from government statistical offices and World Bank Group country departments. The database manifests significant differences in quality and frequency of data between continents and between countries. In general, longer and more frequent series are available for Latin American and Asian countries, African datasets are less frequent with fewer observations and the most recent observations often being out-dated.

Finally, the weighting system used in the national level MCES (w_i) uses information on Food Supply (expressed in kcal/capita/day) from FAOSTAT food balance sheet. The conceptual limitations of this method are linked to the data source and related to the compromises applied to calculate the MCES. Regarding the data source, per capita food supply available for human consumption is obtained from macro data:

$$Food\ Supply\ =\ ((production +\ imports) - (exports +\ stock\ variations)).$$

This information only reflects the amount of food available in a country not the actual share of food consumed. Same consideration of data quality is valid in this case, especially in relation to stock variation information.

A final reflection on the data limitations concerns the fact that the value of the weights is dictated by the availability of prices of certain items. In most cases, significant items in the Dietary Energy Requirement are matched with the price relative to the item but, when this is not possible, the MCES only considers a suboptimal set of commodities.

Conclusions

The chapter illustrated an alternative use of the MCES to what had been presented in Chapter 5 and 6 (i.e. MCES at the household level). This Chapter applies macro level data to develop

MCES at the national level. The multiple aggregation levels of the MCES represent an appealing feature, because it allows the monitoring of food price changes on food and nutrition security at different levels of analysis – household and national. However, the discussion points at two limitations of such use of the MCES. The "nutritional" value of the MCES decreases with higher aggregation level, lowering the interpretative power of the MCES in terms of nutritional impacts of food price fluctuations, and data quality and frequency gains further importance when considering higher aggregation levels. This is not to say that the MCES is not suitable for macro level monitoring, but it is important to understand its limitations and employment in terms of an index that can help signalling early stages of food price shocks in a way that is relevant to changes in purchasing power and therefore food and nutrition security.