Food Price Hikes and Household Food Security in Bangladesh and Ethiopia: Examining Children's Vulnerability to Food Insecurity*

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Abstract: The purpose of this paper is to examine the impacts of recent food price hikes on the level of children's food security in households in five sub–districts of Bangladesh and Ethiopia. Based on household food security surveys covering 750 households conducted in 2008 and 2009, this study looks into the Aggregate Household Food Security Index (AHFSI) of households to assess their food security levels. The study also relies on a mix of Household Dietary Diversity Score (HDDS), Coping Strategy Index (CSI) as well as the existence of shocks. Logistic regression is employed to understand the degree of the impacts from food price hikes. In addition, the study introduces other variables under the socio–demographic, agricultural inputs, and economic/income models to understand what factors better explain children's vulnerability to food insecurity in households. The findings suggested that 58.2% of households in Bangladesh and 60.4% of households in Ethiopia were in chronic food insecurity. Stunting and wasting of children were the highest during the peak of the food price hikes. Consumption of food was correlated to the income level of households. This was evidenced by the statistically positive significant Spearman rank correlation coefficient of 0.537 between the impacts of food price hikes and levels of food security. Concentration curves also showed that cumulative distribution of malnutrition was below the forty–five degree diagonal line indicating child malnutrition was highly concentrated among low income households. The dietary diversity score was low, and most households heavily relied on few food items, such as grain and oil/fats. At the height of the food price hikes, households adopted coping strategies that included limiting meal portion size of children. In conjunction with other variables, food price hikes were statistically significant accounting children's vulnerability to food insecurity in households.

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1. INTRODUCTION

The underlying purpose of this paper is to examine the impacts of the recent food price hikes on the extent and direction of vulnerability of children to food insecurity in households in five sub–districts of Bangladesh and Ethiopia. It estimates the role that food price hikes have played in accounting/triggering or exacerbating the degree of children's vulnerability to food insecurity in households. It also statistically tests the role of food price hikes with other possible determinants of vulnerability to food insecurity.

The Food and Agriculture Organization (FAO) considered Bangladesh and Ethiopia as one of the thirty–seven countries in 'crises' due to the rise in food prices. Food price hikes in the two countries were accompanied by increasing macro–economic inflation and reliance on food aid/imports. Governments in the two countries faced foreign currency constraints due to soaring prices of fuel imports, and they were unable to provide subsidies or higher wages. As a consequence, there has been no homogeneity of degree zero in prices and income, which assumes that if price and income increase by the same proportion or percentage, there is no change in demand.

An average household in both countries spends close to two–third of its income on food. Among the group defined as poor in Bangladesh and Ethiopia, only 8% were small net sellers in 2000 and 2001 (World Bank 2008). Food price inflation in Ethiopia was 81.1% in September 2008, one of the highest in the world. It has reduced reserves to US $ 900 million which is equivalent to 1.2 months of imports (IMF 2009). This was further exacerbated by the 2007/2008 failure of the small rains (*Belg*) (World Bank 2008). The costs for children have not been limited to direct nutritional impacts, but they have also extended to affect their future as 58% of rural households in Bangladesh pulled their children from school due to food price hikes (Raihan

2009: iv).

Population growth has been very fast in both countries, and between 1990 and 2007, an average 36% of the population in Bangladesh and 45% in Ethiopia was under the age of fourteen (UNPF 2008; World Bank 2008). They faced large–scale famines, and the 1974 famines in both countries marked widespread death with estimated combined figures of one million people and huge loss of rural assets (Sobhan 1979; Sen 1982; Hussein 1976; Zewde 1976; Dessalegn 1985). As Tables 1 and 2 show, food prices doubled in both countries, which are assumed to have affected households' food security levels. This is because a change in the production, access and consumption patterns of households in agrarian societies first directly affects the health and nutritional status of children. Households adopt different coping strategies in relation to the degree of change and availability of strategies, and quite often adoption of seasonal coping strategies show reduction in the amount and quality/diversity of diet accessible to children.

Table 1: Food price hikes in Ethiopia (%, 2004– 2008)

	2006	2007	2008 (Partial)
National	14	22	35
Addis Ababa	21	28	33
Afar	15.7	26	32
Amhara	14	27	35.8
B. Gumuz	14.7	24	46.8
Dire–Dawa	13.5	20	31.5
Oromia	14.5	24	36.7
SNNRP	18.3	17	31.5
Somale	15	9	23
Tigray	9	21	40

Source: Computed from annual average retail price surveys of Central Statistics Authority (CSA) of Ethiopia.
Note: Prices were collected mainly from traders, which also included consumers' reports at the time of purchase. In case of weighing items, the minimum weight conducted was only on items above 10 grams.

Table 2: Average Price trends of rice and wheat in Bangladesh (2007–2009)

	Retail Price		Wholesale price	
	Rice	Wheat	Rice	Wheat
July	0.45	0.43	0.44	0.42
August	0.45	0.30	0.43	0.41
September	0.43	0.43	0.42	0.40
October	0.42	0.40	0.41	0.38
November	0.39	0.37	0.37	0.33
December	0.37	0.30	0.35	0.27
January	0.35	0.25	0.32	0.25
February	0.33	0.26	0.31	0.25
March	0.30	0.2	0.28	0.21
April	0.27	0.21	0.25	0.19
May	0.27	0.21	0.25	0.20
June	0.27	0.21	0.25	0.21

Source: Computed from Bangladesh Bureau of Statistics (BBS), Ministry of Agriculture, Government of Bangladesh
Note: Values are in UD dollar (1 USD = 70 Taka)

The economic foundations of Bangladesh and Ethiopia are predominantly dependent on agriculture which supports close to 30% and 50% of GDP, respectively. As high as 80% to 85% the population live in rural areas and agriculture constitutes 63% of the total labour force in Bangladesh and 81% in Ethiopia. The two countries are probably better known for poverty, the images of starving children and series of appeals for help from the international community than other issues. This study does not set the goal of dispelling such pervasive and deep–ingrained perceptions. It does not also intend to comparatively examine the impacts of food price hikes on the food (in)security levels in the two countries. First, as can be seen in the coming sections, the household dietary diversity score (HDDS), which measures the amount of food groups or items that households consume, differs in the two countries. This leads to different scales and outcomes. Second, the two countries have underlying historical, geographical, and socio–economic differences; yet, there are some important similarities in the nature, trajectories and scopes of the challenges that rural communities face.

2. SIGNIFICANCE OF THE STUDY

Understanding the impacts of food price hikes on the vulnerability of children to food insecurity serves as the base for formulating pertinent disaster prevention and preparedness policies. It has also the potential for relatively increasing the efficacy of external assistance. The magnitude and direction of the impacts have received wider coverage and calls for urgent actions to minimize short and long–term negative impacts on vulnerable communities in agrarian societies. This is mainly because before the onset of widespread food price shocks, global food insecurity has already been the major killer and cause of incapacitating livelihood assets of the majority of poor people. United Nations agencies report that food insecurity claims more lives than the combined number of death from HIV/Aids, tuberculosis and malaria (FAO 2005; WFP 2009). Even a closer historical look at disasters in the world shows that food insecurity kills more people than wars (Shaw 2007: x). It is estimated food price hikes in conjunction with other externalities have increased the number of chronically food–insecure people to an additional 109 million and have pushed further 126 million below a dollar a day life (United Nations 2009: 26).

Food price hikes have also seemed to reinforce our understanding on how deeply international food markets are globalized, easily wielding strong influence on domestic food production and access. Countries heavily reliant on subsistence agriculture have gradually felt the impacts. Resource–constrained and low income developing countries do not have in place institutional mechanisms to assist vulnerable groups much less to absorb the shocks. If not to the extent of Nobel Laureate Lord John Boyd Orr's contention that 'peace cannot be built on empty stomachs', soaring food prices induced poor people in many parts of the world to go to the streets and display 'their perspectives on social justice in a globalizing world' (Hossain 2009: 330). Governments, in turn, as in Bangladesh, China, Cambodia, Ethiopia, India, the Philippines, Pakistan, Thailand, Vietnam and others rushed to impose export controls on agricultural commodities as well as other measures, which are evaluated by different stakeholders differently.

At the methodological level, food price instabilities have brought to the fore long–standing debate on measurements of food security. The emphasis in most studies has been on household food security measurement. This is derived mainly from neo–classical economics that takes the household as a utility maximizing unit. The approach, however, blurs the degree of vulnerability of individual members of a household. It is assumed that women and children, often taken as the weakest members of households at least in traditional/patriarchal societies, are more vulnerable and they seek and adopt higher and more frequent seasonal coping strategies.

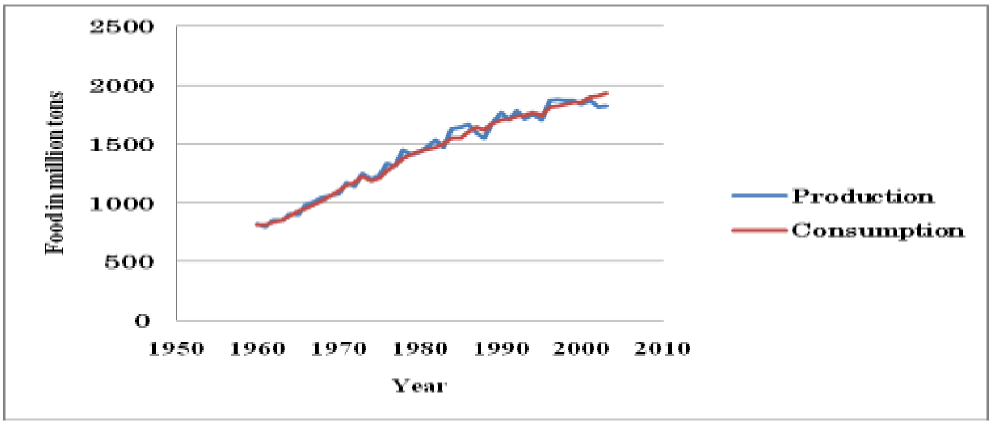
The rest of this paper is organized as follows. Section three reviews the main causes and stylized facts of the food price hikes. Section four presents the findings, and the last part is the conclusion.

3. Reviewing Causes of Food Price Hikes

Described by the World Food Program (WFP) as the 'silent tsunami', the 2007/2008 food price hikes were precipitated and caused by a number of interdependent and mutually reinforcing factors. In fact, soaring prices of food items had started quite well before their peak during 2008. Global prices of rice, wheat, corn, coarse grains and oilseed doubled between 2005 and 2007. Current food price hikes were not fundamentally unique to some of the characteristics of the food crisis in the 1970s. Financial and oil crises, drought, and population growth were part of both periods. During the crisis in the 1970s the level of disaster prevention and recovery among countries was not well developed, which was one reason for prolonging the instability. The current food price hikes also challenged different countries to balance their trade, consumer and producer–oriented policies in view of the problem. Any comparison between the two crises in terms of price hikes should take into account deflation of the nominal prices and putting them in constant terms of a base year. Yet, the food insecurity level, its inclusion of new factors, and the complexity and speed of the impacts that transcend across most commodities make the current crisis distinct. The underlying causes constitute falling food stocks and droughts, speculation in forward and futures trade and devaluation of US dollar, increased use of grains for feedstock and production of biofules, and consumption pattern changes in emerging economies. Some of these factors are transitory while others are structural.

Fundamentally, the food entitlement decline (FED) approach contends that global food problem is not essentially an issue of production, but the capability of enabling people to have access to food (Sen 1981; Dreze and Sen 1989; Smith *et al*. 2000). Inefficient food distribution systems have played a role in exacerbating food insecurity, even though there are indications that regional imbalances in global food production have been at the center of the problem. During late 1990s, food availability per capita increased and it contributed to an improvement in aggregate food security. This was not steadfast and it was marked by volatilities and sharp price falls due to the Asian financial crisis. In 2005 world grain reserves/stocks were at their lowest fifty–four days (Holt-Giménez and Kenfield 2008: 3; also Headey and Fan 2008). In 2007/2008 the ratio of global cereal stocks to utilization was estimated to be the lowest at 19.4% (FAO 2008). Increasing world population, fragmentation of arable land, and water scarcity remain arduous challenges to the capacity of global food production system (Rosegrant 2001; von Braun 2007). Major grain producers such as Australia, the US, the EU, Canada, Russia and Ukraine were hit by droughts, which led to stagnation of production and supply. As can been seen from Table 3, cereal production both in Asia and East Africa (in particular) had negative percentage of change in 2008 from 2007.

Figure 1: Trends in food (grain) production and consumption (1950–2008)



Source: Computed from FAOSTAT

Table 3: World cereal production[1] (million tones)

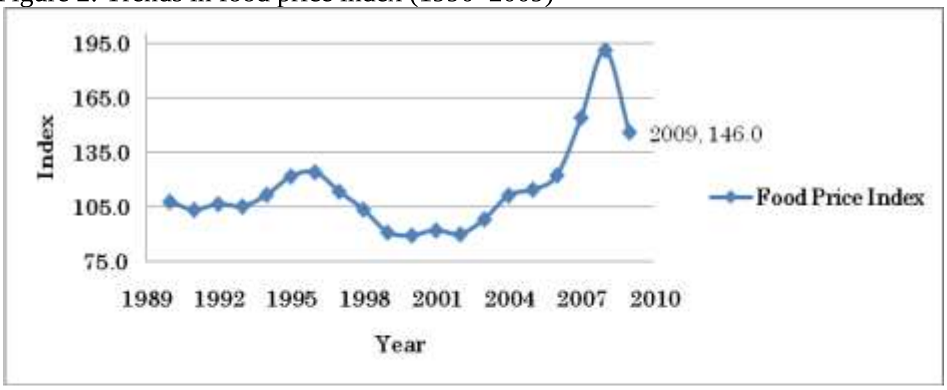
	2006	2007	2008	Change: 2008 over 2007 (%)
Asia	913.6	944.4	943.2	-0.1
Far East	811.0	842.5	851.3	1.1
Near East in Asia	72.7	68.3	62.3	-8.9
CIS in Asia	29.7	33.5	29.4	-12.2
Africa	142.7	133.1	142.8	7.3
North Africa	36.0	28.9	31.9	10.5
Western Africa	49.5	47.3	50.3	6.3
Central Africa	3.2	3.3	3.3	1.4
Eastern Africa	32.5	31.5	31.4	-0.4
Southern Africa	21.5	22.1	25.9	17.3
Central America & Caribbean	36.9	40.0	41.9	4.7
South America	110.7	130.7	138.3	5.8
North America	384.5	462.1	432.5	-6.4
Europe	404.7	388.8	445.0	14.5
EU[2]	246.8	259.6	294.9	13.6
CIS in Europe	118.6	115.6	133.1	15.2
Oceania	20.0	22.8	37.8	65.6
World	2 011.8	2 120.6	2 180.2	2.8
Developing countries	1 155.9	1 195.8	1 213.5	1.5
Developed countries	855.9	924.7	966.7	4.5
- wheat	596.9	608.1	658.3	8.3
- coarse grains	985.7	1 074.4	1 077.6	0.3
- rice (milled)	438.1	438.1	444.3	1.4

Source: FAO (2008). 'Crop Prospects and Food Situation', no. 3, July, p. 6
Notes: [1]Includes rice in milled terms. [2]EU-25 in 2006; EU-27 in 2007, 2008; Totals computed from unrounded data.

Volatilities of grain prices date back to the First World War with regular steep rise reaching 50% and followed by price stability for some years (Atkin 1995: 84). The Green

Revolution contributed to price fall of grains despite unintended socio–economic consequences and the failure to expand the results from Asia to Sub–Saharan Africa, a region where sixteen of the eighteen highly undernourished countries are located. Figure 2 shows the cumulative price flows of six commodities (meat, dairy products, cereals, oils and sugar) for two decades. There were no major hikes or declines except until 2004/05. The price index increased by 9% in 2006 and subsequently climbed to 23% in 2007. While the price of sugar fell by 32% after 2007, dairy products showed the highest increase by 80%, followed by oils with 50% and grains with 42%. Focusing on wheat, Sekhar (2003) showed that stagnant domestic production accompanied by changes in import–export volumes as well as rising population resulted in drop in per capita availability and subsequent increase in domestic price.

Figure 2: Trends in food price index (1990–2009)



Source: Computed from FAO Food Price Index data

The increase in food prices ensued commodity prices of oil, metals and fertilizer. Among grains, wheat rose first, and it was followed by rice, maize, and soybeans. During the peak between March 2007 and March 2008, the prices of wheat, soybeans, rice, and corn increased by 130%, 87%, 74% and 31%, respectively. By July 2008 prices started to stabilize (FAO 2008). Due to high volatilities in short period, speculation in forward and futures trade by investors who moved from unstable financial to commodity markets was suspected to have been one cause. In the first quarter of 2008, it was estimated global grain futures and options rose by 32% from 2007 (UNCTAD 2008: 5; Mitchell 2008). The head of the U.N. Environment Program, Achim Steiner, believed that markets and supplies were ‘influenced by perceptions of future market [which was] distorting access to food’ (Associated Press 2008).

In addition, most central banks in developing countries pegged their currencies to the US dollar. The spiral effects of food price hikes in these countries were therefore difficult to avoid. Because of the increasing depreciation of the dollar for several months in real terms before the peak of the food price hikes, the dollar values of global food grain rose more than the price expressed in other currencies. These currencies lost their purchasing power more than the dollar and they could accordingly buy less food items. It was estimated that the depreciation of the US dollar from January 2002 to June 2008 increased food prices by about 20% with an elasticity of 0.75 (Mitchell 2008).

Another factor raised as a cause for the food price hikes was using agricultural land to produce biofuels and feedstock. Chiefly the US, Brazil and the EU encouraged biofuels from food crops in a drive to lessen their dependency on oil from traditional petroleum exporting countries. Whether decisions such as ‘turning the corn belt of America from the bread basket of the world into an enormous fuel tank’ (Vidal 2007) were strongly connected to the food price hikes has been the focus of the debate. The discussion took into account different regions with varying degrees of resource and technological endowment (Rosegrant 2008; Koh and Ghazoul 2008; James *et al*. 2008). Economic models tested the trade–offs in terms of cost and efficiency between using land to produce crops for fuel/feedstock and food (for calculations see Elobeid *et al.* 2006; Schneider and McCarl 2003; Msangi *et al.* 2007; Elobeid and Tokgoz 2008). While oil from crops is premised to possess potential sources of alternative energy, its caveats in terms of displacing some crops for others, increased competition for water, and accelerating deforestation are pointed out (Rosegrant *et. al*. 2008).

Concurrently, the changing consumption patterns of growing middle class population in emerging economies from starchy foods to meat and dairy products was thought to have boosted the demand for feed grains. Consumer purchases become less responsive to the prices of food items. Economic growth in countries, such as China and India, as well as global population growth shift from rural to urban areas, where in the next thirty years 61% of the world population is estimated to live, have engendered demand (van Braun 2007: 1).

4. THE SURVEYS AND DISCUSSION OF FINDINGS

The study covered randomly selected 750 households. Household questionnaires suitable to the nature and composition of rural households in the sub–districts were administered. Group discussions with informants and meetings with a number of governmental and non–governmental organization (NGOs) were held. A 24 hour observation for seven days was made in selected households, and interviews were conducted with the chief executives and staff of local governments. The survey in Bangladesh was conducted in the districts of Rangpur (Gangachara), Manikganj (Saturia) and Bagerhat (Sharon Khola) while in Ethiopia it covered South Wello (Kalu) and Eastern Tigray (Astbi Wonberta). The surveys were conducted at the different peaks of the price hikes, and this helped in checking changes in the consumption patterns of households. This study did not conduct clinical examinations of the health status of households. Besides, longer time–framework is needed to understand the changes in a better way for the post–food price hikes phases. This study did not also examine and compare households' food security levels before the food price hikes. The objective is to assess current food security level based mainly on food price hikes and other determinants to estimate future vulnerability to food insecurity.

The AHFSI was used to indicate current food security level of children in households in the research sites based on assessing the impacts of the food price hikes. The AHFSI takes the following form:

$$AHFSI= 100-[H \{G + (1-G) IP\} + 0.5\ \Omega\ \{1-H [G-(1-G) IP]\}]\ 100 \qquad (1)$$

***H*:** head count of proportion of the total children undernourished
***G*:** measure of extent of the food gap of the average undernourished households' of children shortfall in dietary energy supplies from national average requirements for dietary energy
I^{P}: measure of inequality in the distribution of food gaps based on the Gini-coefficient.
***Ω*:** the coefficient of variation in dietary energy supplies, which gives the probability of facing temporary food shortage.

H was calculated based on the Body Mass Index (BMI) of children dividing the weight (*W*) in kilograms by height (*H*) squared in meters ($BMI = W/H^2$). From 150 households in each district of Bangladesh, a total of 1,399 children participated in the study. Out of 495 children 40% (198) in Gangachara, out of 473 children 33.3% (157) in Saturia, and out of 431 children 37.3% (160) in Sharon Khola were found undernourished. A total sample of 225 households each in Kalu (Southern Wello) and Atsbi Wenberta (Eastern Tigray) including 729 children were part of the surveys. In Kalu, out of 390 children 40.44% (158) and out of 339 children in Atsbi Wenberta 41.33% (139) were found undernourished. Both in Bangladesh and Ethiopia the measurement excluded children who were breastfeeding. For pregnant or lactating women, an allowance for extra calories needs was considered. Taking the total population to be equal to one, then the undernourished population of children (the value of *H*) would be .40 in Gangachara, .333 in Saturia, .373 in Sharon Khola, .4044 in Kalu and .4133 in Atsbi Wenberta.

Stunting and wasting of children were serious both within the undernourished and the general sampled children. Stunting refers to proportion of children under five below minus 2 standard deviations (moderate) and minus 3 standard deviations (severe) from the median height–for–age compared to a reference height for children of the same height. Wasting indicates proportion of children under five below minus 2 standard deviations (moderate) and minus 3 standard deviations (severe) from the median weight–for–height compared to a reference weight for children of the same weight. The reference standards are developed by the World Health Organization (WHO) and the US National Centre for Health Statistics (NCHS) as well as data compiled by FAO. Figure 3 shows the variations in mean percentage stunting (sever and moderate) as well as wasting (sever and moderate) in Bangladesh.

Food gap (value of *G*) was calculated based on the average of each household's calories intake. The average calorie intakes of 60 households in Gangachra, 50 households in Saturia and 56 households in Sharon Khola was calculated, which were 1,400 Kcal, 1,464 Kcal and 1,443 Kcal, respectively. Rice was used for computing the calorie intakes since more than 80% of the rural population consume rice. For example, husked or brown (only hulls removed) has calorie value of 357, home–pounded under–milled, parboiled 359, and milled white rice 360 (measured in 100 grams edible portion). The average daily consumption is around 350. The gap between the average requirement and the average availability was 34.02% in Gangachra, 31% in Saturia and 32% in Sharon Khola. Taking the average requirement to be equal to one, the gap would be 0.3402 (with 0.6598 availability), 0.31 (with 0.69 availability) and 0.32 (with 0.68 availability).

The calorie intakes of the undernourished sample of 91 households in Kalu and 93 households in Atsbi Wenberta were then calculated, which was 1,350 and 1,344 Kcal, respectively, and these figures were well below the minimum which was between 1,660 and 1,680 Kcal from 1990 to 2005 (FAO 2008). Cereals were used for computing the calories. For example, *teff* has the calorie value of 367 and *gebs* (barley) 361 (measured in 100 grams edible portion). The gap between the average requirement and the average availability was computed to be 750 for Kalu and 800 for Atsbi Wenberta, which was converted into percentage as 35.71% and 36%. Taking the average requirement to be equal to one, the gap would be 0.3571 (with availability of 0.6429) and 0.3809 (with availability of 6191), respectively.

The values of the Gini coefficient 0.40 for Gangachra, 0.43 for Saturia, 0.42 for Sharon Khola, 0.41 for Kalu and 0.40 for Atsbi Wonberta were computed based on the average income of the households from the surveys. The values of coefficient of variation (CV), which are related to the probability of facing temporary food shortage, were 10 for Gangachra, 6 for Saturia, 9 for Sharon Khola, 7 for Kalu and 8 for Atsbi Wonberta. These figures took into account the dietary diversity score, asset ownership (land and cattle) and coping strategy index so as to reflect the degree/probability that the villages in question would face transient food shortage or stress.

Saturia had the highest level of food security (77.14%) followed by Sharon Khola (69.96%) while Gangachara was the lowest (57.53%). Households in Saturia were hard hit during the 1998 flood and the majority lost their land and assets. However, the strong social network and income from remittance (from Saudi Arabia, Malaysia, and Singapore) helped communities resuscitate their assets within a decade, and this has not been substantially affected by the current financial crises (World Bank 2008: 6). The lower value in Sharon Khola was also due to the 2007 cyclone *Sidr* that claimed more than 3,000 lives and washed away the agricultural assets of many households. Recovery has been very slow with relief aid still continuing for the third year while essential development interventions such as embankment have been ignored or too expensive to implement. Gangachara, home to one of the largest concentration of the 'ultra–poor' with landless households of the district's 33,696 (35%), has been prone to disaster from the Teesta river where as many as 5,000 landless households are concentrated along the river shore. It is a place where greenery veils chronic food insecurity.

Kalu (55.37%) and Atsbi Wonberta (53.15%) in northern Ethiopia were in worse chronic food insecurity in relation to the sub–districts in Bangladesh.

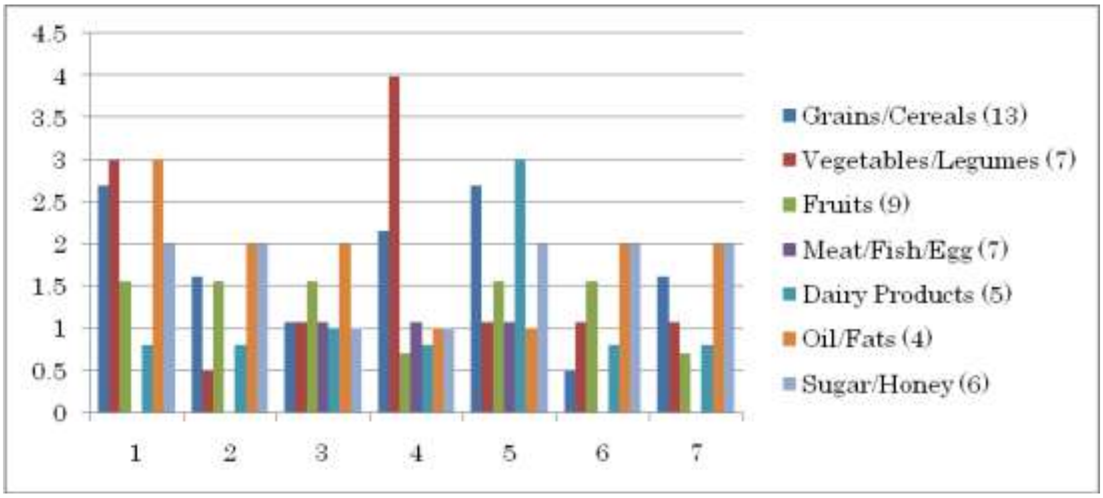
Table 4: AHFSI of sub–districts in Bangladesh and Ethiopia

Gangachra	100 - [0.40{0.3402 + (1 - 0.3402)0.40} + 0.5*8{1 - 0.40[0.3402 - (1 - 0.3402) 0.40]}] 100 = *57.53%*
Saturia	100 - [0.333 {0.31 + (1 – 0.31) 0.43} + 0.5*6 {1 – 0.333 [0.31 - (1 – 0.31) 0.43]}] 100= *77.14%*
Sharon Khola	100 - [0.373 {0.32 + (1 – 0.32) 0.42} + 0.5*0.42 {1 – 0.373 [0.32 - (1 – 0.32) 0.42]}] 100= *69.96%*
Kalu	100 - [0.4044 {0.3571 + (1 – 0.3571) 0.41} + 0.5*7 {1 – 0.044 [0.3571 - (1 – 0.3571) 0.41]}] 100= *55.37%*
Atsbi Wonberta	100 - [0.4133 {0.36 + (1 – 0.36)0.40} + 0.5*7 {1 – 0.4133 [0.36 - (1 – 0.36) 0.40]}] 100= *53.15%*

Source: Field surveys

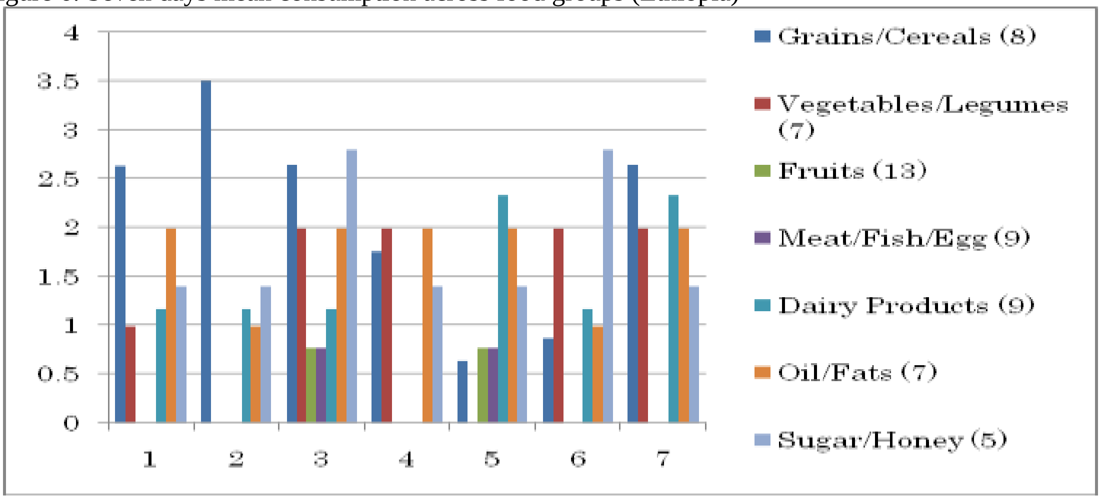
Given the existence of shocks from health, disaster and economy/income of households in the past one year, HDDS of households below 6.00 and CSI above 107 were taken as a reference point to classify households as currently food–insecure. While the index for coping strategies used in Bangladesh was the same for households in Ethiopia, the dietary diversity score used as a base was below 6.2. There were 51 food items for the sites in Bangladesh and 55 for Ethiopia. The calorie intake for households classified as food–insecure based on the scores and indices were less than 2,122 Kcal for Bangladesh (RDRS 2005; BBS 2006; Mishra and Hossain 2005) and less than 2,100 for Ethiopia (WFP 2008; MOFED 2002). As can be seen from Figures 7 and 8, most family member including children in households of Bangladesh and Ethiopia on average depend on oil/fats as well as sugar for daily energy. In terms of grains consumption, households in Ethiopia relied on items such as *teff*, wheat, and maize (mean 2.09) while households in Bangladesh consumed oil/fats (mean 1.85) followed by grain (mean 1.76). The overall dietary diversity score was not encouraging, and 24 hour observations showed children and other family members heavily relied on few food items.

Figure 5: Seven days mean consumption across food groups (Bangladesh)



Source: Field Surveys.
Note: numbers in parenthesis are number of food items consumed. See measurement for computation.

Figure 6: Seven days mean consumption across food groups (Ethiopia)



Source: Field Surveys.
Note: numbers in parenthesis are number of food items consumed. See measurement for computation.

In addition, consumption of food is correlated to the income level of households. This is evidenced by the statistically positive significant Spearman rank correlation coefficient of 0.537. Rank effects of food price hikes (no effect, low effect, moderate effect and high effect) were tested against rank level of food security (food–secure, with transient food insecurity, with chronic food insecurity and with acute food insecurity) (for details of the classification, see FAO 2006; USAID 2007). This can further be shown by drawing concentration curves of cumulative income and malnutrition distribution (Figures 9 and 10). Since the cumulative distribution of malnutrition is below the diagonal line, the relationship is regressive in which child malnutrition is highly concentrated among low income households. Thus, food price hikes are assumed to have affected the food access and consumption of low income group households.

Figure 7: Concentration curves for income and child malnutrition in Bangladesh

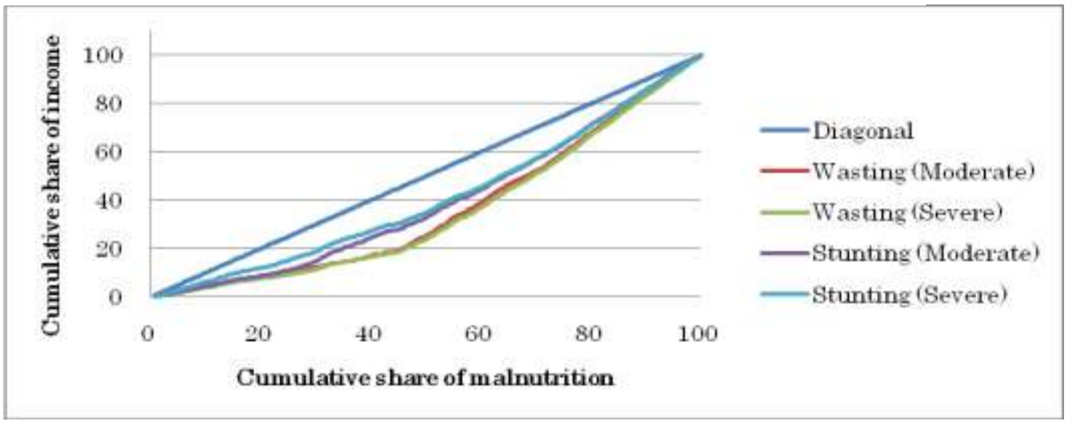
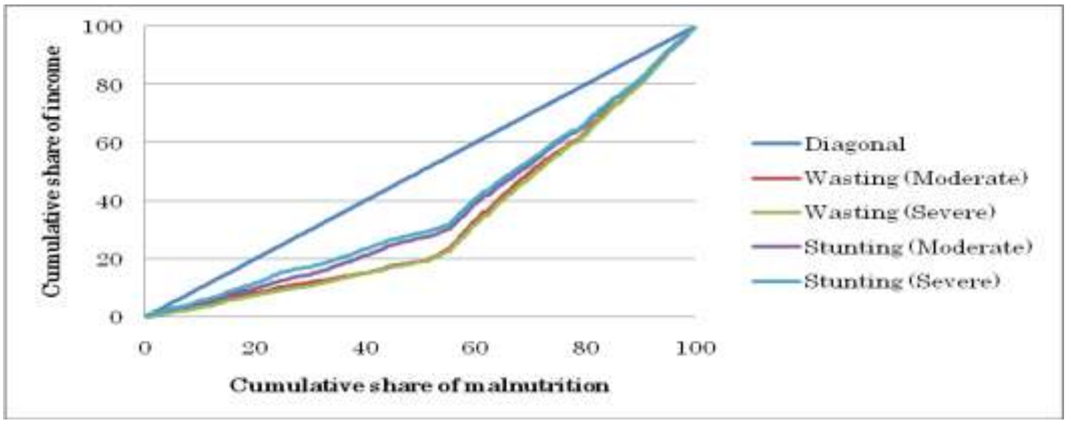


Figure 8: Concentration curves for income and child malnutrition in Ethiopia



Source: Field Surveys.

With chronic food insecurity levels, high wasting and stunting values, low dietary diversity scores and regressive distribution of income and malnutrition, households resort to different long–term and seasonal coping strategies. The mechanisms adopted enabled households to offset stress, but they had negative impacts on nutritional status of vulnerable groups such as children. A list of eleven coping strategies was identified in the five sub–districts as shown in Table 5. The CSI ranges from a minimum of 84 (indicting better food security level) to a maximum of 130 (indicating a worse condition). At the peak of the food price hikes, the highest seasonal coping strategies were adopted in all the research sites. Figure 9 points out the level at which households adopt limiting meal portion size of their children.

Table 5: List of coping strategies and their rank by households

Rank	**Coping Strategy**
1.	Eat less preferred food
2.	Reduce the number of meals per day
3.	Borrow money from relatives to buy food and seek work in urban or other rural areas (laborer, rickshaw puller)
4.	Borrow food from relatives or neighbors
5.	Gather or eat wild foods
6.	Skip meal for the whole day by adult members of the household
7.	Send children to eat with relatives or neighbors
8.	Limit meal portion size of children
9.	Consume seed stock kept for the next season
10.	Skip meal by the entire family for the whole day
11.	Begging

Source: Field surveys

Figure 9: Coping strategy index across households in Bangladesh and Ethiopia

Limit meal portion size of children

Source: Field Surveys.

We now turn to statistically test to what extent food price hikes account children's vulnerability to food insecurity in households. Table 6 shows the variable definition and the descriptive statistics. Cases with potential problems of residuals distorting the outcome were checked based on Cook's Distance, Leverage, Studentized Residual and Standardized Residual. The Cook's Distance should commonly be less than one. Leverage was computed by adding a value of one to the number of predictors and dividing them by the total sample. In this case the value was 0.01 and nearly all the cases were close to this value. For Studentized Residual, 5% of the cases should be between ±1.96, and 1% should be ± 2.58, and for Standardized Residual cases above 3 may have excessive influence. There were no serious problems based on these criteria. Correlation coefficients among predictors were checked for possible problem of multicollinearity. The tolerance statistics was between the range of .335 and .973, the Variance Inflation Factors (VIF) values changed between 1.027 and 2.087, and the maximum Condition Index was 15.588. These figures were acceptable values and there was no problem of multicollinearity. In addition, running the correlation coefficient among the independent variables showed values less than 0.4.

Table 6: Variable definition and descriptive statistics (n=750)

Variables	Definition	Mean/Percentage	
		Bangladesh	Ethiopia
FOODINSECURE	Whether a household is currently food–insecure. 1= if food–insecure 0= otherwise	58.2%	60.4%
FOODHIKE	The impact of food price hikes on households (ranking)		
	1= No effect	8%	9%
	2= Low	11%	17%
	3= Moderate	20%	23%
	4= High	61%	51%
FAMSIZE	The number of people in a household living and eating together	5.16	6.21
HEAD (Dummy)	Head of the household: 1= if female–headed 0= otherwise	31.8	33.3
EDU	Education in year of schooling of the household head	1.28	1.33
NONFARM	Non–farm income of the household in USD (2002)	513.63	128.15
REMITTANCE (Dummy)	Whether a household received remittance from abroad: 1= if yes 0= otherwise	35%	12%
CREDIT	Credit received in US dollar	48.49	19.48
PROPAR (Dummy)	Participation of projects funded by aid: 1= if yes 0= otherwise	36.2%	63%
FARMSIZE	Land size owned by the household in hectare	0.41	1.19
CATTLE	Cattle owned by the household (in TLU) [a]	1.48	2.61
FERTILIZER	Fertilizer used by the household in kilograms	11.86	6.33
WATER (Dummy)	Household water access: 1= yes if irrigation/dam 0= otherwise	50.2	26.7

Note: [a] TLU = tropical livestock unit, which compares different kinds of livestock. One TLU represents approximately 250 kilograms of live–weight animal. 1 cattle = 1 TLU, 1 poultry = 0.005 TLU, 1 goat = 0.15 TLU, 1 horse = 1 TLU, 1 donkey = 0.65 TLU, 1 mule = 1.15 TLU, 1 camel = 1.45 TLU. TLU is imprecise in informing biomass because of variations in weights and species.

Tables in the Appendix show the results of the logistic regression and the different models used to test the probability of children' vulnerability to future food insecurity in households. The estimates for the coefficients for the predictors in this model represented the change in the logit of the outcome variable. An increase in the price of food was statistically significant in accounting children's vulnerability to food insecurity in households. The Wald statistic (77.23) showed this predictor was significantly different from zero confirming it could serve as a good estimator of the outcome. The value for Wald statistic, however, is not reported because of the inaccuracy associated in inflating the standard error when the value of the coefficients is large. Instead the *exp b* is reported, which is the change in odds due to the changes in the independent variables. When the value of *exp b* is greater than one, it points out that with an increase in the predictor the odds vulnerability to food insecurity increase. On the other hand, a value less than one reveals when the predictor increases, the odds of vulnerability to food insecurity decrease. Thus, an increase in food price by one US dollar would have the probability of decreasing the HDDS and increasing the CIS of a household by 2.5 in Bangladesh and 1.28 in Ethiopia. The value for the confidence interval for this predictor was greater one. This increased the confidence that the values for the *exp b* in the population would fall within the ranges.

The -2 Log likelihood of using food price increase shows the strength or accuracy of the variable in predicting outcome in vulnerability to food insecurity. In other words, its value should be less than when only the constant is employed in the regression. The value in the constant indicated 620.923 for Bangladesh and 615.032 for Ethiopia. It declined to 456.763 for Bangladesh and 458.16 for Ethiopia, attesting this predictor was much better when the significant variable of food price was included. The Hosmer and Lemeshow Goodness–of–Fit Test is used to test the hypothesis that the observed data of children's vulnerability to food insecurity in households are significantly different from the predicted values. The non–significance value of .660 in Bangladesh and .441 in Ethiopia suggested the model predicted actual data well. The overall model accounted 21% in Bangladesh and 23% in Ethiopia of the variances in children's vulnerability to food insecurity in households, which indicated that more than 79% in Bangladesh and 77% in Ethiopia of children's vulnerability to food insecurity in households were not explained by food price hikes.

In the socio–demographic model, family size, education and household head were used. Only education and family size were found to be significant in accounting for changes in children's vulnerability to food insecurity in households both in Bangladesh and Ethiopia. Controlling for other variables, an increase in the family size by one person would have the probability of decreasing the HDDS and increasing the CIS of a household by 2.5 in Bangladesh and 1.28 in Ethiopia. An increase in education by one year of schooling would have the probability of increasing the HDDS and decreasing the CSI of a household by .77 in Bangladesh and .488 in Ethiopia, when other variables were controlled. The non–significance value of .760 in Bangladesh and .537 in Ethiopia supported the model predicted actual data well. The overall model accounted 27% in Bangladesh and 26% in Ethiopia of the variances in children's vulnerability to food insecurity in households, which suggested that more than 73% in Bangladesh and 74% in Ethiopia of children's vulnerability to food insecurity in households were not explained.

The third model included factors in agricultural inputs of farm size measured in hectares, cattle (oxen and cows) measured in TLU, fertilizer use in kilograms and water availability constituting irrigation/dam. Only farm size and fertilizer use were found to be statistically significant in predicting the probability of children's vulnerability to food insecurity in households both in Bangladesh and Ethiopia. Controlling for other variables, an increase in one hectare of land holding would have the likelihood of increasing the HDDS and decreasing the CSI of a children's vulnerability to food insecurity by .26 in households in Bangladesh and by .11 in Ethiopia. Using one kilogram of fertilizer would have the probability of increasing the HDDS and decreasing the CSI of children’s vulnerability to food insecurity by .95 in households in Bangladesh and .932 in Ethiopia. The values for the confidence interval for the two predictors were less than one, which increased the confidence that the values for the *exp b* in the population would fall within these ranges. Cattle ownership and water access, contrary to the expectation of this study, were not found to be statistically significant. When compared to the model with only the constant which was 58.4% in Bangladesh and 60.4% in Ethiopia, the agricultural input model improved the general accuracy of the model to 80.4% in Bangladesh and 84% in Ethiopia. This was better than both food price hikes variable and the socio–demographic model. However, the Hosmer and Lemeshow Goodness–of–Fit Test showed non–significance value of .054 in Bangladesh and .59 in Ethiopia, which barely predict actual data well.

The fourth model consisted economic/income factors such as remittance, non–farm income, credit and project participation or aid receipt. All these predictors except remittance were found to be statistically significant in explaining children’s vulnerability to food insecurity in households. Holding other variables constant, earning a dollar as non–farm income would have the probability of increasing the HDDS and decreasing the CSI of children’s vulnerability to food insecurity by .98 in households in Bangladesh and .97 in Ethiopia. Besides, earning a dollar as credit would have the likelihood of increasing the HDDS and decreasing the CSI of children’s vulnerability to food insecurity by .99 in households in Bangladesh and Ethiopia. If a member of a household participated in a project or received aid, it would have the probability of increasing the HDDS and decreasing the CSI of children’s vulnerability to food insecurity by .20 in households in Bangladesh and by .22 in Ethiopia. This model accounted for 63% of the variance in children’s vulnerability to food insecurity in households. However, the Hosmer and Lemeshow Goodness–of–Fit Test for Ethiopia was very significant ($p<.05$) and the model lacked accuracy/stability in predicting actual data.

Finally the full model included all the variables that were statistically significant in predicting vulnerability of children to food insecurity in households. The forward stepwise (likelihood ratio) method was employed, which included the constant and it added predictors into the model on the basis of the score statistics (cut–off .05). Seven predictors (food price hikes, household head, family size, farm size, non–farm income and fertilizer) in Bangladesh and five predictors (food price hikes, education, farm size, non–farm income and project participation/aid receipt) in Ethiopia were statistically significant in accounting changes in the odds of children's vulnerability to food insecurity in households. Controlling other variables, female–headed households in Bangladesh would experience the likelihood of losing in HDDS and increasing in CSI by 8 compared to male–headed households, which is a very high figure. However, looking at the 95% CI indicated that the ranges were very wide, and the mean of the sample might not be a good representative of the 'true' mean in the population. To draw a conclusion that if a female–headed household with HDDS of 5 would have zero score (a state of no eating any food by the household) would be misleading. Thus, this predictor tends to be unreliable.

An increase in food price by dollar would have the probability of decreasing the HDDS and increasing the CSI of households by 1.2 in Bangladesh and 1.1 in Ethiopia. An increase by one person of family size would have the probability of decreasing the HDDS and increasing the CSI of households by 2.7, while using an additional one kilogram of fertilizer would have the likelihood of increasing the HDDS and decreasing the CSI of households by .93. Owning an extra one hectare of land would have the probability of increasing the HDDS and decreasing the CSI by .07 in Bangladesh and by .22 in Ethiopia. Earning an extra one dollar as a non–farm income would have the likelihood of increasing the HDDS and decreasing the CSI of households by .98 in Bangladesh and .99 in Ethiopia. An increase of schooling by one year would have the probability of increasing the HDDS and decreasing the CSI of households' vulnerability by .789 while a household's participation in projects or receipt of aid would have the likelihood of increasing the HDDS and decreasing the CSI by .269 in Ethiopia. This model was able to account for 76% of the variation of children's vulnerability to food insecurity in households with Hosmer and Lemeshow Goodness–of–Fit Test value of .084. The model for Ethiopia accounted for 50.6% of the variation of households' vulnerability to food insecurity. The Hosmer and Lemeshow Goodness–of–Fit Test value was non–significant (.410). The variables not in the equation table for the models both in Bangladesh and Ethiopia showed that predictors not included were all non–significant, which indicated their coefficients were significantly different from zero. The model if term removed output also showed all the significant predictors would have affected the accuracy and reliability of the models' prediction had they been removed.

5. CONCLUSION

It was shown that food price hikes, alone or in combination with other variables, accounted predicting the probability of children's vulnerability to food insecurity in households. It is perhaps plausible to take the food price hikes of 2007/2008 as one manifestation of the greater and deeper problem of food insecurity. As von Braun (2009: 9) suggests, the issue is an indication of 'long–term failures in the functioning of the world food system'. Different actors and policy makers have explored various ways of tackling the problem even though specific measures are yet to be discussed and considered in earnest. This is especially true given the scope and seriousness of the problem in low income agrarian societies such as Bangladesh and Ethiopia, where malnutrition and child mortality are one of the highest. Addressing the problem, thus, is linked to laying the ground for physically capable, healthy and mentally fit children for the future of these countries.

Most family member including children in households of Bangladesh and Ethiopia on average depended on oil/fats as well as sugar for daily energy. In terms of grains consumption, households in Ethiopia relied on items such as *teff*, wheat, and maize (mean 2.09) while households in Bangladesh consumed oil/fats (mean 1.85) followed by grain (mean 1.76). The overall dietary diversity score was not encouraging, and 24 hour observations showed children and other family members heavily relied on few food items.

In addition, consumption of food was correlated to the income level of households. This was evidenced by the statistically positive significant Spearman rank correlation coefficient of 0.537. Rank effects of food price hikes (no effect, low effect, moderate effect and high effect) were tested against rank level of food security (food–secure, with transient food insecurity, with chronic food insecurity and with acute food insecurity). At the peak of the food price hikes, the highest seasonal coping strategies were adopted in all the research sites. Statistically, it was shown that controlling for other variables, an increase in food price by dollar would have the probability of decreasing the HDDS and increasing the CSI of households by 1.2 in Bangladesh and 1.1 in Ethiopia.

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Appendix

Table 1: Logistic Regression Results of Models for Children's Vulnerability to Food Insecurity in households in Bangladesh

Variables	Food price Hikes	Socio–Demographic	Agricultural Inputs	Economic Income	Full Model
Constant	1.342** (0.214)	-4.277*** (.014)	1.563*** (4.8)	7.658*** (2119)	1.999 (7.5)
FOODHIKE	0.624** (2.50) 1.350, 2.063	0.453 (1.24) 0.125, 1.012	.231 (1.234) 0.410, 1.324	.354 (1.32) (0.245, 1.322	.231** (1.2) 1.023, 1.623
FAMSIZE		.909*** (2.5) 2.022, 3.05			.992*** (2.7) 1.7641, 4.125
HEAD		.196 (1.22) .731, 2.03			2.076** (7.9) 2.125, 29.880
EDU		-.266*** (.77) .670, .877			.012 (1.012) .762, 1.344
NONFARM				-.012*** (.98) .986, .991	-.013*** (.98) .984, .991
REMITTANCE				-0.114 (.125) 1.234, 0.140	-0.121 (0.032) 1.254, 0.124
CREDIT				-.003*** (.99) .981, .993	.000 (.999) .990, 1.009
PROPA				-1.226** (.293) .134, .644	-472 (.624)
FARMSIZE			-3.643*** (0.26)		-2697* (0.7)

							.008, .085						0.006, 7.14		
CATTLE							.251 (1.3) 1.02, 1.621						.211 (1.234) .739, 2.061		
FERTILIZER							-.053*** (.95) .927, .971						-.074** (.93) -889, .969		
WATER							.347 (1.42) .862, 2.323						.103 (1.109) .465, 2.642		
- 2 Log likelihood	456.763			446.755			397.200			225.579			141.002		
Cox and Snell R^2	.347			.306			.378			.575			.648		
Nagelkerke R^2	.452			.509			.509			.775			.873		
Hosmer and Lemeshow Goodness–of–Fit Test	x^2	df	Sig.	x^2	df	Sig.	x^2	df	Sig.	x^2	df	Sig.	x^2	df	Sig.
	3.58	8	.660	4.98	8	.760	13.87	7	.054	10.94	8	.205	12.13	8	.145

Note: Numbers in parentheses indicate exp b and figures below them are 95% CI
*p<.05, **p<.01, **p<.001

Table 2: Logistic Regression Results of Models for Children's Vulnerability to Food Insecurity in households in Ethiopia

Variables	Food price Hikes	Socio–Demographic	Agricultural Inputs	Economic Income	Full Model
Constant	2.314** (1.24)	.071 (1.074)	0.342** (1.032)	1.247 (11.21)	3.788** (44.183)
FOODHIKE	0.541** (1.28) 1.251, 2.192	0.124 (1.35) 0.124, 1.354	0.475 (1.42) (0.425, 1.365)	0.145 (1.52) 0.745, 1.245	.214** (1.1) 1.010, 1.523
FAMSIZE		-.288 (.750) .455, 1.235			.153 (1.17) .998, 1.361
HEAD		.248*** (1.28) 1.129, 1.453			-.247 (.78) .412, 1.481
EDU		-.717*** (.488) .416, .574			-.226* (.798) .645, .987
NONFARM				-.029*** (.97) .965, .978	-.010* (.990) .983, .998
REMITTANCE				-0.124 (.145) 0.145, 1.245	-0.147 (.214) .724, 1.244
CREDIT				-.010** (.990) .981, 1.00	.002 (1.002) .991, 1.013
PROPA				-1.492*** (.225 .131, .387	-1.315*** (.27) .145, .497
FARMSIZE			-2.19** (.11) .068, .183		-1.506*** (.22) .123. .401
CATTLE			-0.12 (.988)		.091 (1.09)

							.895, 1.202						.881, 1.361		
FERTILIZER							-.070** (.932) .895, .972						-.052 (.949) .899, 1.002		
WATER							.305 (1.36) .743, 2.478						.088 (1.09) .559, 2.133		
- 2 Log likelihood	458.16			447.179			339.698			349.477			293.557		
Cox and Snell R^2	.254			.294			.444			.432			.498		
Nagelkerke R^2	.325			.398			.601			.585			.67		
Hosmer and Lemeshow Goodness–of–Fit Test	x^2	df	Sig.	x^2	df	Sig.	x^2	df	Sig.	x^2	df	Sig.	x^2	df	Sig.
	2.354	8	.441	7.00	8	.537	15.015	8	.059	28.14	8	.001	6.45	8	.597

Note: Numbers in parentheses indicate exp b and figures below them are 95% CI
*p<.05, **p<.01, **p<.001