HNP DISCUSSION PAPER

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Evidence from Repeated Cross-sectional and Panel Data

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Health, Nutrition and Population (HNP) Discussion Paper

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Health, Nutrition and Population (HNP) Discussion Paper

The Impact of the Food Price Crisis on Consumption and Caloric Availability in Pakistan: *Evidence from Repeated Cross-sectional and Panel Data*

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Abstract:

Welfare losses from the 2008 food price crisis in Pakistan are deepening the gap between poor and nonpoor populations and further increasing inequality between the provinces. To estimate welfare losses, the reduction in caloric availability at household level is measured. The analysis of calorie intake by source supports the notion that rural households were shielded from the worst effects of the crisis by their capacity to grow their own food. Compensating variation estimates suggest that the average household would need 38 percent of its total precrisis expenditure to maintain precrisis consumption levels. The impact of the food price crisis (measured as the percentage of total expenditure required to restore consumption to the precrisis level) peaked at the end of 2008 to twice as high as at the start of the year. Average household caloric availability fell by almost 8 percent between 2006 and first half of 2008. Urban households were relatively worse off than rural households during the crisis. Income gains from sales of agricultural commodities produced by rural households presumably offset the negative impact of the food crisis to some degree. The drawdown of assets over 2008–10 was another important coping mechanism, especially for households without access to land.

Keywords: Food Crisis, Compensating Variations

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Table of Contents

FOREWORD

As part of its technical assistance to the Government of Pakistan, the World Bank initiated the Pakistan Programmatic Social Protection Policy Notes in 2009. The main objective of these notes was to facilitate effective design, development, and implementation of a national safety net system under the Benazir Income Support Program (BISP). In addition, these notes were meant to inform overall social protection policy in Pakistan.

Opinions expressed in these policy notes are entirely those of the authors. They do not represent official views of the Executive Directors of the World Bank, the Trust Fund Donors, or the Government of Pakistan.

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1. INTRODUCTION

Global food prices have almost doubled over the past seven years (FAO Food Price Index). From 2007 to 2008 alone, the price of wheat and rice rose by 121 percent and 76 percent, respectively (World Bank 2010a). In many cases, these price rises have persisted. Domestic food prices in 45 developing countries remained higher in 2009 than before the crisis (FAO 2009).

The rising cost of food is expected to worsen poverty and further limit human development in many developing countries. The 2008 food price crisis is projected to worsen poverty for a significant portion of the 2.3 billion people living on less than US$ 2 per day, and another 100 million are likely to join the numbers of the poor (Ivanic and Martin 2008). In addition to the direct impact on monetary measures of poverty, the reductions in real income caused by rising food prices could worsen nutrition, limit the use of educational and health services, and cause the poor to deplete their few productive assets. A recent study found that calorie intake and household dietary diversity declined in Afghanistan during the 2008 food crisis (D'Souza and Jolliffe 2010). Evidence from past crises clearly indicates that children suffer long-term health consequences from short-term shocks (Alderman, Hoddinott, and Kinsey 2006; Friedman and Sturdy 2010). Although the evidence is mixed, aggregate economic shocks may reduce educational attainment because the opportunity cost of keeping children in school may increase (Ferreira and Schady 2009). Rising food prices may also force poor households with low coping capacity (because of inadequate credit markets, for example) to invest less in their livelihoods or sell their livestock and other productive assets (Carter and others 2004; Lokshin and Ravallion 2000; Cater and others 2007).

Pakistan, like much of the developing world, was a victim of the global food crisis. From 2005 to the end of 2008, the domestic wheat price rose by 106 percent. Prices of other staple foods rose between 20 and 120 percent, while nonfood prices rose only 17 percent on average.[1] The price of wheat in Pakistan was affected not only by the global food crisis but by domestic hoarding and smuggling of wheat, caused by the relatively low wheat price in Pakistan compared to neighboring countries during 2007. To prevent farmers from hoarding and smuggling, Pakistan increased the procurement price of wheat. However, by 2009 this practice had caused the domestic price of wheat to rise beyond the international wheat price (Ministry of Finance 2008). The floods that coursed through Pakistan in 2010 are expected to reduce wheat production and further raise prices. For Pakistanis, high wheat prices are particularly critical because wheat accounts for nearly 50 percent of the mean daily calorie intake.[2] A large relative change in the wheat price has substantial implications for levels of poverty and human development in Pakistan.

1. Based on the price change calculation described in the results section.

2. Based on PSLM 2005–06.

To respond to rising food prices, in 2008 the Government of Pakistan initiated the Benazir Income Support Program (BISP), which provides cash transfers of Pakistan Rupees 1,000 to poor families identified by the government on the basis of its poverty scorecard census. The program's primary objective is to mitigate the impact of the food crisis on consumption. Given the continuing volatility of wheat prices in Pakistan, a greater understanding of the past and continuing impact of the food crisis is valuable for informing the discussion on whether and how the country should scale up its safety net programs.

We focus on variations in the wheat price, because wheat is the single most important commodity for a typical Pakistani household. Using three rounds of the Pakistan Social and Living Standard Measurement Survey (PSLM), from 2005–06, 2007–08, and 2010, this note examines the distributional and welfare impact of the food crisis through the following measures:

(1) The compensation required following the 2008 price increases to return households to consumption levels prevailing before the crisis (2005–06)[3] Estimated impact of the food crisis varies depending on how the analysis accounts for households' capacity to substitute less expensive commodities for those previously consumed, and households' capacity to produce selected food commodities themselves. For that reason, this note presents a range of estimates. It also attempts to trace welfare changes across the entire period of food price increases in 2008 rather than at a particular point in time.

(2) The loss of caloric availability over the course of the initial food price crisis between 2006 and 2008. The change in available calories at the household level will vary by location and by the availability of productive assets such as agricultural land.

(3) The changes in caloric availability in relation to changes in the wheat price between 2008 and 2010. The analysis benefited from recently collected panel data to trace the behavior of households as they coped with sustained price increases over that period.

The analysis helps to identify which groups have been most seriously affected by Pakistan's food price crisis. Studying the impact of rising food prices over time rather than at one particular moment provides a more complete understanding of how the impact of the crisis has unfolded among different groups. In addition to analyzing the welfare impact in monetary terms, this note looks at changes in a simple yet critical dimension of welfare: household calorie consumption. Findings from the caloric availability analysis highlight the differential ability of urban and rural households to cope with the food crisis. They emphasize the protective effect of households' capacity to produce their own food when prices are rising rapidly.

3. The compensating variation is expressed as a percentage of total household expenditure

2. DATA AND METHODS

2.1. DATA

The main data sources used for the analysis are three rounds of the PSLM, a nationally representative survey covering 14 large cities and 81 districts, including urban and rural areas. The survey records information on a range of social issues, including education, employment, immunization, women's decision making, and household consumption. In the consumption module, in addition to 79 nonfood items, the survey collects data on the quantities and values of 58 consumed staple food items while distinguishing between purchased, self-produced, and gifted, and in-kind quantities of staple foods.

The three survey rounds used in the analysis were fielded in July 2005–June 2006 (the precrisis period); July 2007–June 2008 (the onset of the food price crisis); and January–June 2010 (after a period of sustained price increases).[4] Households interviewed in January–June 2008 were interviewed again in January–June 2010 within the same calendar quarter. The first two rounds of data are relevant for analyzing welfare before the crisis and during its onset, since food prices began increasing in late 2007 and continued to rise throughout 2008. On the other hand, the panel nature of the last two rounds of data (January–June 2008 and 2010) from PSLM allows us to identify how price changes affected welfare at the household level, and provides detailed insight into households' coping mechanisms.

To measure the effect of the price shocks, individual food and nonfood items in the PSLM are matched to the retail prices of individual commodities obtained from Pakistan's Federal Bureau of Statistics (FBS). Since 1991, FBS has collected retail price data on 374 goods and services covering 10 fairly exhaustive consumption categories from 71 markets in 35 cities.[5]

The 58 staple food items in the PSLM were matched to the retail price data from FBS (the food items are listed in Appendix Table 4). The present analysis aggregated the individual food items into 11 food groups: dairy products; meat; fruit; vegetables; spices; wheat; rice; other cereals; pulses; oil; and other food. Price changes for each item were aggregated using the budget share of each item within its group as a weight. For example, the dairy product category includes five different food items, such as milk and yogurt, each with its own price change. The price change of the dairy product was calculated as

4. Questionnaires and sample design in all rounds are consistent. Summary statistics in both rounds are shown in Appendix Table 1.
5. The 10 nonfood groups are: food and beverages; apparel, textiles, and footwear; house rent; fuel and lighting; household furniture and equipment; transport and communication; recreation and entertainment; education; cleaning, laundry, and personal appearance; and medical care.

the weighted average of the price change of each constituent item. The price of the aggregate nonfood category was the weighted price of the corresponding nonfood items.

To reflect the geographic variation in food prices, each district in the PSLM data was matched to the nearest urban center where the retail price data for both food and nonfood items were collected. Given that retail prices in rural areas are matched to prices in urban centers, caution should be used when interpreting the results, because price changes in rural and urban areas can differ. Rural impacts may be overestimated if price changes in a rural area were smaller than those in the nearest urban area (the opposite is also true; rural impacts can be underestimated). Based on the matched information about price changes and household consumption of the 12 aggregate goods (11 food and 1 nonfood), we estimate the compensating variation and changes in caloric availability between the two study periods.

Lastly, self-reported consumed quantities of 58 staple food items in the PSLM were converted to caloric measures based on nutritional values in Pakistan to represent household-level caloric availability. The food consumption module in the PSLM utilizes either a fortnightly or monthly recall, depending on the item; fortnightly measures were converted to monthly consumption.[6] Because PSLM separately collects information on consumed quantities of purchased foods, self-produced foods, and foods obtained as a form of wage, the caloric availability from purchased foods and self-produced foods could be identified. Caloric information was also disaggregated by source for the analysis into calories obtained from grain, vegetables and fruit, animal products, and other sources.[7]

2.2. METHODS

We use two methods to understand the impact of the food crisis on household welfare. The first method estimates the compensating variation, as suggested by Friedman and Levinsohn (2002), to understand the magnitude of the food price crisis in terms of the additional expenditure necessary to maintain a reference level of welfare. The second method is a regression analysis using pooled cross-sectional and panel data to capture the effects of the food price crisis on household caloric availability.

2.2.1. Compensating Variation

Welfare changes arising from the food price crisis are proxied by the estimated compensating variation (CV), which is defined as the income necessary to compensate the household in order to maintain its precrisis utility level. Following Friedman and Levinsohn (2002), we use precrisis information on household consumption along with price data over the crisis period to forecast the distributional consequences of relative

6. See Appendix Table 4.

7. Grains include wheat, rice, other cereals, and pulses; animal products include dairy products and meat;and other food includes spices and oils.

price changes as captured by the CV. These projections can then be assessed for accuracy and updated as post crisis household data become available. The main method is summarized below.

Compensating variation (CV) is derived using the first-order Taylor series expansion around the minimum expenditure function, $e(p,u)$, with respect to price, p, at a fixed baseline utility level, u_0.

$$CV = e(p_0, u_0) - e(p_1, u_0) = \frac{\partial e(p, u_0)}{\partial p}(p_1 - p_0)$$

Simply replace $\frac{\partial e(p, u_0)}{\partial p}$ with q, the consumption quantity, and the CV can be expressed as a price change and baseline consumption quantity.

$$CV = q\Delta p$$

Reformulating this equation, the CV can also be expressed as a function of the budget share (w_i) and proportional price changes.

Equation 1

$$\frac{CV}{\sum_{i=1}^{n} q_i p_i} = \sum_{i=1}^{n} w_i \frac{\Delta p_i}{p_i}, \text{ where } w_i = \frac{q_i p_i}{\sum_{i=1}^{n} q_i p_i}$$

The summation function is indexed over the n consumption goods available to the households. This first-order Taylor expansion does not take into account the possibility that a household can substitute one good for another, depending on the relationship between the two goods and the magnitude of the relative price change. However, the ability to substitute particularly costly goods with less costly items could mitigate the negative impact of the food price crisis. To capture the substitution effect in the CV calculation, the second-order Taylor expansion with some algebraic manipulation can be expressed as:

Equation 2

$$\frac{CV}{\sum_{i=1}^{n} q_i p_i} = \sum_{i=1}^{n} w_i \frac{\Delta p_i}{p_i} + \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} w_i \varepsilon_{ij} \frac{\Delta p_i}{p_i}\frac{\Delta p_j}{p_j}$$

This expression includes the own-and cross-price elasticity terms, ε_{ij}, which is the price elasticity of good i with respect to good j for each of the n goods, and incorporates the substitution behavior of households attributable to price increases in one good over another.

The own and cross-elasticity of each good is estimated using the methodology developed by Deaton (1997), which utilizes the geographic variation in the unit value of a good. As only spatial variation is utilized to identify the elasticity terms, elasticities are estimated using the second-round PSLM (2007–08), which is the more relevant period for estimating the demand changes, given the large spatial divergence in prices after 2007.[8] Additionally, a households' ability to produce certain important foods may lessen the negative effect of the food crisis on the household's welfare. We allow for this possibility in robustness exercises that treat consumption from self-production as a negative expenditure and re-estimate the compensating variations, following Friedman and Levinsohn (2002).

2.2.2. Changes in Caloric Availability Prior to and During the Onset of the Crisis

The method just described leverages information on consumption patterns measured before the crisis. This second method employs information collected during the crisis to examine information on one key welfare indicator before and during the crisis. We use pooled cross-sectional data—incorporating 2005–06 (round 1) and 2007–08 (round 2)—to measure changes in caloric availability between the two rounds. Caloric availability is one indicator of household welfare that is presumably directly affected by the food price crisis. As the relative price of food increases, households substitute, at least partially, the foods experiencing the most rapid price increases, with corresponding changes in caloric availability for the household. In addition, a price increase may cause households that consume but do not produce food to experience a negative real income shock, whereas food-producing households may experience a positive income shock, which may in turn affect total calories consumed.

Since we do not observe the same households over the first two rounds of the PSLM, it is a challenge to determine the exact food consumption changes between the two periods; food prices vary by region and season within Pakistan. However, food prices should be substantially more stable within individual districts and quarters of the year. By controlling for the district and quarter of the observation through fixed effects, however, we can compare changes in average household caloric availability between the two rounds. Based on the PSLM survey design, we compare the two observed quarters in 2005 with the corresponding quarters in 2007 (July–September and October–December), and the two quarters in 2006 with the corresponding quarters in 2008 (January–March and April–June). The following regression equation is estimated:

Equation 3

$$\ln(Calorie_{hqtd}) = \gamma_0 + \gamma_t T + \gamma_q Q + \gamma_{tq}(T * Q) + \gamma_x X_{hqtd} + \gamma_d D + e_{hqtd}$$

8. Results are qualitatively the same if the first-round PSLM is used to estimate the elasticity terms (results available upon request).

The log calories consumed is indexed by household *h* measured in quarter *q*, survey round *t*, and residing in district *d*. A complete set of dummy indicators for survey round, *T*, quarter, *Q*, and district, *D*, are included in the specification. The coefficient of the interaction term between *T* and *Q*, γ_{tq}, captures the changes in caloric availability over the crisis period. In the absence of a food price crisis, we would expect γ_{tq} either not to be significantly different from zero, reflecting no change in caloric availability, or to be slightly positive if the caloric consumption within the season and district increases as a result of economic growth. We include quarter dummies to control for the seasonality of food consumption and possible variation in prices. The regression also includes household-level characteristics, X_{htq}, to better balance the cross-round comparison by controlling for observable household demographic and socioeconomic information. Since the food price crisis started at the beginning of the year 2008, we would expect γ_{tq} to be the most negative in the first and second quarters of 2008 as opposed to the last two quarters of 2007.

In addition, we examine changes in calories available from purchased goods compared to self-produced goods. Since the decision to consume self-produced goods is due to economic considerations in producing households, which can in turn be affected by the food crisis, we model the changes in calories available from self-produced goods using a two-stage model. First, the probability of consuming from self-production is estimated using a Probit specification; then, based on consumption from self-production, the change in caloric availability is estimated using Ordinary Least Squares (OLS). If indeed the capacity to produce food partially protects households from the price increases, access to agricultural land can be an important determinant of welfare. For this reason, the analysis distinguishes between urban and rural households and, within rural areas, between landed and landless households.

Lastly, we investigate changes in dietary composition between the two periods. Since the price of grain increased more dramatically than the prices of other goods, we would expect calories obtained from grain to decrease the most during the crisis. We estimate the caloric availability from different sources: grain, animal products, vegetables and fruit, and others.

2.2.3. Impact of Price Changes on Caloric Availability, Panel Household Analysis

This method benefits from the panel aspect of the PSLM and makes use of household-level information collected in the shock and post-shock periods. As in the previous method, in this approach the measure of welfare is caloric availability, and geographic variations in price changes between two periods help to identify household-level responses to food shocks. We focus on variations in the wheat price, because wheat is the single most important commodity for a typical Pakistani household (on average, 48 percent of total caloric availability is from wheat), and the wheat price data show a great deal of spatial and temporal variation.

Using PSLM household-level panel data in 2008 (January–June) and 2010 (January–June), a household-level fixed effect model is employed to identify the impact of wheat price changes on household caloric availability. In addition to investigating the average impact of wheat price changes, we investigate the potential mitigating role of land accessibility using the following specification.

Equation 4

$$\ln(Calorie_{ht}) = \beta_0 + \beta_1 \ln(Wheatprice_{dt}) + \beta_2 \ln(wheatprice_{dt}) * Land_{t-1} + \varphi' X_t + \alpha_h + \varepsilon_{ht}$$

Since the same households (*h*) are observed in two periods (*t* and *t-1*) using the household fixed effect model, the effect of changes in the district-level (*d*) wheat price on changes in caloric availability at the household level can be identified. β_1 captures the impact of changes in the district-level wheat price on changes in caloric availability for households with no access to land in 2008. β_2 shows the differential impact of wheat price changes on the caloric availability in households with and without access to land.

The same outcome measures investigated in the preceding analysis are investigated here: total caloric availability; caloric availability from purchased foods; caloric availability from self-produced goods; and the probability of consuming self-produced goods. The linear probability model is used to estimate the probability of consuming self-produced goods.

3. COMPENSATING VARIATION

3.1. BUDGET SHARES AND FOOD PRICE INCREASE

Among food categories, dairy products have the highest mean household budget share (table 1): On average, 16.5 percent of household expenditure went to dairy products before the food crisis. The second most important food good in terms of budget share was wheat, at 13 percent of household expenditure. The next most important aggregate goods are spices (including sugar) at 9.15 percent of the household budget, meat at 7.17 percent, vegetables at 6.98 percent, and oil at 6.79 percent.

The budget share of each aggregate food category varies across the income distribution. The poor spend proportionally more on wheat, oil, spices, and vegetables, but less on meat, milk, and fruit. Wheat consumption accounts for about 20 percent of the total household expenditure for the poorest 10 percent (as defined by per capita household expenditure) and only 4.7 percent for the top 10 percent of households. The top 10 percent of households spend a significant share on nonfood items: 43 percent compared to 22 percent for the average household; the difference is statistically significant.[9]

9. Standard errors are reported for the comparison between the bottom 10 percent and the top 10 percent of households in the per capita household expenditure distribution.

Table 1. Budget Share of Individual Aggregate Goods and Their Price Changes

	Budget Share (%), 2005–06					Price Change (%)
	All households	Bottom 10%		Top 10%		All households
Dairy	16.47	12.22	(0.29)	14.68	(0.24)	42.01
Meat	7.17	5.09	(0.20)	9.43	(0.22)	24.52
Fruit	2.50	1.38	(0.06)	3.41	(0.08)	42.11
Vegetables	6.98	9.06	(0.14)	4.10	(0.08)	9.38
Spices	9.15	11.16	(0.13)	5.66	(0.11)	13.10
Wheat	12.99	20.83	(0.24)	4.67	(0.11)	79.74
Rice	2.59	2.93	(0.12)	1.58	(0.05)	173.19
Cereals	0.17	0.13	(0.01)	0.17	(0.01)	5.99
Pulses	1.89	2.37	(0.06)	1.09	(0.03)	43.24
Oil	6.79	8.12	(0.11)	4.31	(0.09)	86.88
Other foods	1.45	0.73	(0.05)	2.74	(0.08)	12.14
Nonfood	27.88	21.80	(0.32)	43.33	(0.48)	16.55

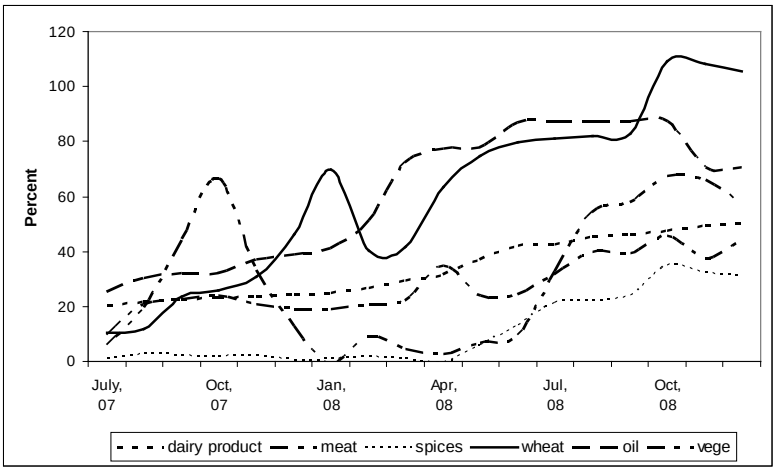
Source: Authors' Calculation based on PSLM 2005-06 and retail prices from FBS
Note: Standard errors in parentheses for the comparison between bottom 10 percent and top 10 percent; the price change is between the month that the household was surveyed in 2005-2006 and June, 2008. This price change is used in the CV calculation.

Most staple food prices increased gradually until early 2008, started to rise dramatically in early to mid-2008, and remained high until the end of the year. Figure 1 shows proportional price changes (in percent) between 2005–06 and 2007–08[10] for six aggregate staple goods.[11] Among the six staple goods, the price of wheat increased most dramatically; by December 2008, it was 106 percent over the 2005–06 price.

10. In price change calculations, the baseline price is the retail price prevailing in the month when the PSLM 2005–06 respondents were interviewed about their food consumption.

11. Dairy products, wheat, spices, meat, vegetables, and oil are the six most important aggregate food goods in terms of budget share (from high to low).

Figure 1. Proportional Price Changes (%) Compared to 2005–06 for Six Selected Aggregate Goods



Source: Authors' Calculation based on PSLM 2005-06 and retail prices from FBS

The distributional implications for the price changes depend on precrisis consumption patterns as well as the magnitude of the relative price changes between goods. For example, as household expenditure increases, the budget share of both wheat and oil decreases, suggesting that increased prices for these two goods will affect the poor disproportionately. The price of rice increased 173.2 percent from 2005–06 to June 2008, but the impact may not have been particularly significant, given that rice accounts for only 2.6 percent of Pakistani household budgets. Dairy products and meat are more important goods for the nonpoor than for the poor, and their prices rose modestly, implying a relatively smaller impact on richer households.

3.2. COMPENSATING VARIATIONS

3.2.1. Compensating Variations for Each Composite Food Catogory

Table 2 presents estimates of the CV for each aggregate food good as a percentage of household expenditure based on budget share and price changes of aggregate goods estimated in June 2008. The most prominent impact of the food crisis was the increased wheat price. The average household needed to spend an additional 10.5 percent of its total expenditure on wheat prior to the crisis to maintain its precrisis level of wheat consumption. Poor households were affected much more than others by rising wheat prices: The bottom 10 percent of households would need compensation of 17.9 percent of household expenditure to maintain their precrisis wheat consumption level, whereas the top 10 percent of households would need only 3.8 percent. Rice and oil price increases also affected poor and rich households differently, primarily because of their relative

importance in the household budgets of the poor. Price changes of other aggregate goods, on the other hand, affected the poor and the rich to a similar extent.

Table 2. Compensating Variation for Each Aggregate Good
(Percentage of total household expenditures)

	All households	Bottom 10%		Top 10%		Poor households
Dairy	7.05	5.25	(0.15)	6.18	(0.12)	5.70
Meat	1.86	1.26	(0.05)	2.34	(0.06)	1.35
Fruit	1.33	0.71	(0.06)	1.99	(0.09)	0.75
Vegetables	0.62	0.90	(0.05)	0.25	(0.03)	0.86
Spices	1.10	1.40	(0.06)	0.79	(0.03)	1.38
Wheat	10.52	17.85	(0.34)	3.77	(0.09)	16.30
Rice	4.77	5.14	(0.24)	2.99	(0.01)	5.36
Cereals	0.03	0.01	(0.00)	0.04	(0.00)	0.02
Pulses	0.84	1.00	(0.04)	0.52	(0.02)	0.95
Oil	5.78	7.37	(0.12)	3.35	(0.06)	7.11
Other foods	0.25	0.10	(0.01)	0.59	(0.03)	0.11
Nonfood	4.12	3.67	(0.07)	4.78	(0.07)	3.74

Source: Authors' Calculation based on PSLM 2005-06 and retail prices from FBS
Note: Based on the price changes measured in June 2008 compared to 2005–06. Poor households are defined as being at or below the 100 percent poverty line in 2005 and 2006. Standard error is in parentheses for the comparison between the bottom 10 percent and top 10 percent.

The compensating variations incorporating the price changes of all goods are shown in Table 3. Average households need 38 percent of their total expenditures (Rs 3,801 per month) to recover their precrisis utility level, without considering substitution to relatively cheaper goods. Again, poor households generally were affected more than nonpoor households. Poor households would need to be compensated for 44 percent of their total expenditures (an average amount of Rs 2,616 per month), whereas nonpoor households would need only 37 percent of total expenditures. The food price crisis affected rural households more than urban ones, as long as their prospects for producing their own food was not taken into account. Urban nonpoor households would require compensation of 36 percent of their total expenditure and rural nonpoor households 38 percent to recover their precrisis patterns of consumption. Among the poor, urban households were affected to a slightly greater degree by the food crisis; they had an estimated CV of 46 percent versus 43 percent for the rural poor.

Table 3. Compensating Variation (%), without Substitution Effects

	All households	Nonpoor		Poor	
All households	38.3	37.2***	(0.11)	43.6***	(0.35)
Urban	36.6	35.7***	(0.16)	45.6***	(0.42)
Rural	39.1	38.0***	(0.15)	43.2***	(0.41)

Source: Authors' Calculation based on PSLM 2005-06 and retail prices from FBS
Note: Measured in percentage of precrisis household expenditure. Based on price changes measured in June 2008 compared to 2005–06. Difference between poor and nonpoor is significant at 0.01 level (***). Standard errors are in parenthesis for the comparison between nonpoor and poor households.

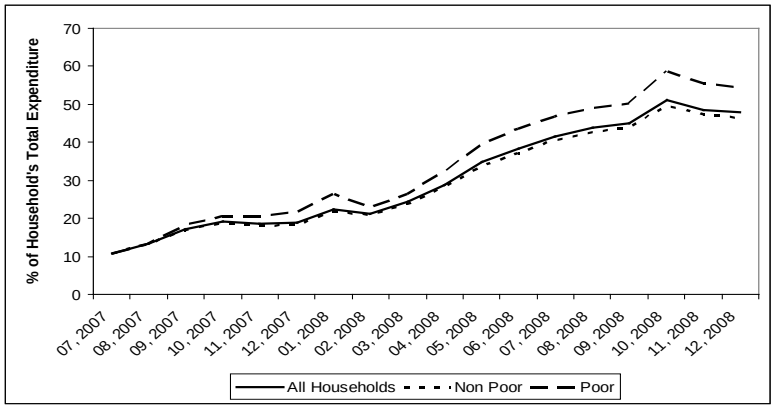
Food prices of staple goods rose continuously and did not peak until October 2008. Depending on when we measure the price changes, the welfare effects of the food crisis might differ. Previous results were based on prices in June 2008, the middle of the food crisis. Figure 2 shows the estimated CVs over time. Compensating variation estimates move along with overall price increases; there is a gradual increase in CV estimates to February 2008, and a dramatic increase over the rest of year. The peak, when the highest level of compensation was needed to maintain precrisis consumption levels, was in October 2008.

Over time, the food price crisis disproportionately affected the poor. For the poor and nonpoor alike, welfare changes were similar in July 2007, but the gap widened: In June 2008, the estimated CV for poor household is 10 percentage points higher than nonpoor household, and this difference persisted until the end of the year (Figure 2). The distributional gap arising from this cumulative change in welfare might be much larger than the welfare change estimated at one point in time.

The CV also exhibits substantial geographic variation,[12] with the widest variation occurring between Punjab and Balochistan (Figure 3). Households in Balochistan were the most adversely affected over the whole period, and KPK was hit hard at the end of the year. The difference in CV changes between Punjab and Balochistan was around 17 percent of total household expenditure in June 2008; the CV for households in Punjab is estimated at 37 percent of total household expenditure and in Balochistan at 54 percent. This regional gap persisted to the end of 2008 and was more severe than the gap between the poor and nonpoor throughout Pakistan.

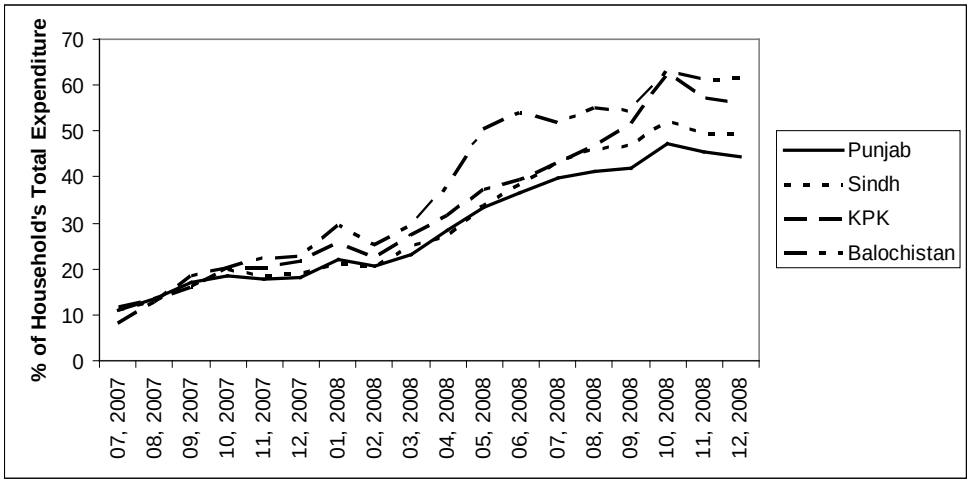
12. PSLM adopted a two-stage stratified sample design and kept sample size at approximately 17,600 households comprising 1,252 sample villages/enumeration blocks, which is expected to produce reliable results at the provincial level (see http://www.statpak.gov.pk/fbs/content/methodology-4).

Figure 2. Welfare Changes During the Crisis Year for the Poor and Nonpoor



Source: Authors' Calculation based on PSLM 2005-06 and retail prices from FBS

Figure 3. Welfare Changes During the Crisis Year, by Region

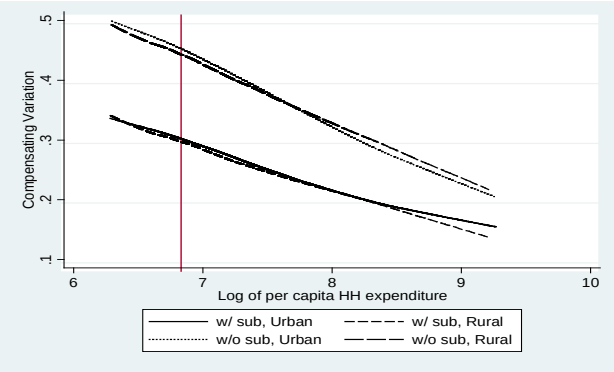


Source: Authors' Calculation based on PSLM 2005-06 and retail prices from FBS

3.2.2. Compensating Variations with Substitution Effects

When prices rise disproportionately among food goods, households substitute cheaper foods for more expensive foods. To capture this substitution effect, the own and cross-price elasticities of each good are estimated using geographic variations in quality and quantity (Deaton 1997). Own and cross-elasticities of composite goods are estimated using the second round of PSLM data, and these elasticities are given in Appendix Table 2. Own-price elasticity estimates are reported on the diagonal of the tables. For example, the own-price elasticity of wheat in 2007–08 is estimated to be –0.430, which is in line with the global estimates of elasticities of key staple commodities.

Figure 4. Compensating Variations, with and without Substitution Effect



Source: Authors' Calculation based on PSLM 2005-06 and retail prices from FBS

When the substitution effect is included in the CV estimates, the compensating variation is substantially smaller than the estimates without the substitution effect. On average, households need 26.9 percent of their total expenditure to recover their previous utility level from consumption. The distributional effect of the food crisis on welfare diminishes in absolute terms when substitution effects are considered, as seen by the changes in slope in Figure 4, which shows nonparametric regression lines of CV as a function of baseline household per capita expenditure. Four lines are presented, two each for urban and rural areas, both with and without substitution effects. When the prices of goods that poor households relied on went up substantially, they substituted cheaper goods for more expensive ones. Substitution lessens the negative effects of high food prices for poor households more than it does for nonpoor households, but the distributional consequences are unchanged: Poorer households still require a greater proportion of their original household expenditure to maintain their consumption. As for urban–rural differences, urban households were affected more across the income distribution, but only marginally.

3.2.3. Compensating Variations with Consumption from Self-produced Food

The effects of the food price crisis may have been tempered by the capacity of many rural households and some urban households to produce some of the food they consume. The mean budget share of self-production was only 3.1 percent for urban households but 21 percent for rural households in 2005–06. Table 4 shows the relative importance of household production for a range of commodities. Rural households, on average, produce 47.3 percent of the dairy products they consume and 34.3 percent of the wheat, whereas urban households produce only 5.8 percent of the dairy products they consumer and 3.9 percent of the wheat. Since dairy products and wheat together accounted for approximately 30 percent of the household budget, a household's ability to produce these goods was likely to lessen the shock of the food crisis.

Table 4. Share (%) of Commodities Produced by the Household for Its Own Consumption

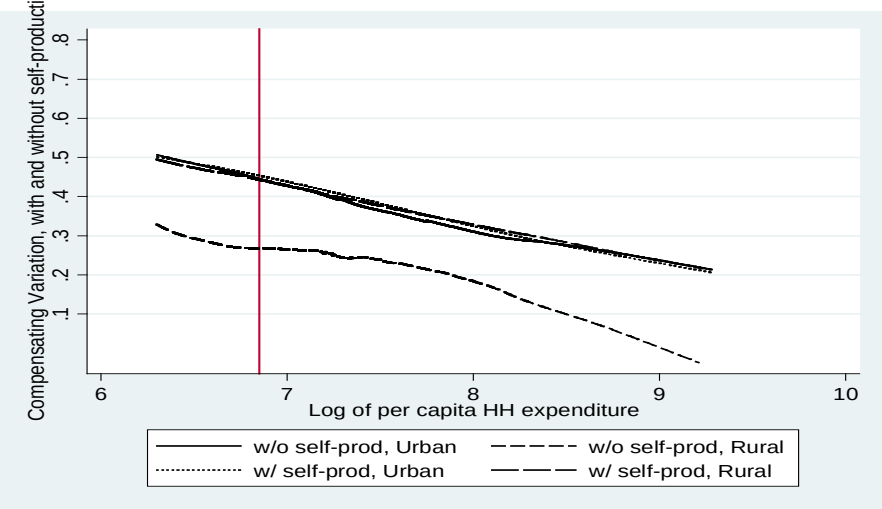
	All households	Urban households	Rural households
Dairy	32.8	5.8	47.3
Meat	9.2	2.0	13.5
Fruit	1.4	0.7	1.8
Vegetables	2.7	0.6	3.7
Spices	1.7	0.6	2.3
Wheat	23.9	3.9	34.3
Rice	9.8	2.0	14.1
Cereals	1.9	0.9	2.5
Pulses	2.1	0.6	2.8
Oil	5.2	1.2	7.4
Other food	8.0	5.0	10.1

Source: Authors' Calculation based on PSLM 2005-06 and retail prices from FBS

To account for the protective role of household food production during the food crisis, an alternative CV was estimated that treats the consumption of self-produced goods as negative expenditures. This change has the greatest implications for welfare effects on rural households (Figure 5). The CV for urban households at any level of household resources is virtually identical regardless of whether their own food production is treated as a negative expenditure. In contrast, the welfare implications for rural households are dramatic. The estimated CVs accounting for the protective effects of household food production in rural areas are approximately 40 percent less at every level of baseline household resources. Although the CV remains higher for poor rural households than for richer rural households, this result shows that self-production buffers many rural households from outside shocks. It indicates that the greatest vulnerability to the food price crisis may be found among poor urban households as well as poor rural households that cannot produce their own food.

This result does not mean that rural households would have consumed the same quantity of self-produced goods as they did before the price crisis. Given the opportunity to sell their agricultural goods at higher prices, households might consider selling rather than consuming the food they produce for themselves. The next section explores the changes in caloric availability from purchased goods and self-produced goods during the crisis. The analysis reveals how rural households responded to the price changes in more detail.

Figure 5. Compensating Variations without Self-Production



Source: Authors' Calculation based on PSLM 2005-06 and retail prices from FBS; the vertical line is the poverty line in 2005-2006

4. CHANGES IN CALORIC AVAILABILITY

4.1. CHANGES IN CALORIC AVAILABILITY, 2005-08

4.1.1. The Changes in Caloric Availability

Turning from projections of impact based on consumption patterns before the food price crisis, we look at estimates based on observed changes in caloric availability. Table 5 depicts the initial regression results for caloric availability. The dependent variable in the first column of results is the log of total calories consumed by the household. The second column looks at calories from market purchases only, while the third investigates log calories from self-produced food. The final column uses a probit specification to explore the probability that a household will obtain any of its calories from food it has produced. The key coefficients in each panel are the final three rows that give the relative change in caloric availability across rounds within the same quarter. Caloric availability in the second round is significantly less and declined over time. In the two quarters of 2008 (January–June, the period most affected by rising food prices), average caloric availability was almost 8 percent less than in the same quarters of 2006.

Table 5.: Total Change in Caloric Availability

	Log(Total Caloric Availability)		Log(caloric availability from purchased food)		Log(Caloric Availability from Self-production)		Pr(caloric availability from self-production>0), Probit	
Year 07/08	0.042**	(0.008)	0.034***	(0.011)	0.225***	(0.051)	–0.037***	(0.012)
Quarter 2	0.030**	(0.008)	0.030***	(0.011)	0.025	(0.050)	–0.037***	(0.012)
Quarter 3	0.030**	(0.008)	0.057***	(0.011)	0.059	(0.051)	–0.037***	(0.012)
Quarter 4	0.027**	(0.008)	0.062***	(0.011)	0.082	(0.053)	–0.038***	(0.012)
Year 07/08 X Quarter 2	–0.044***	(0.011)	–0.020	(0.016)	–0.141*	(0.073)	–0.027	(0.017)
Year 07/08 X Quarter 3	–0.075***	(0.011)	–0.034**	(0.016)	–0.308***	(0.074)	–0.014	(0.017)
Year 07/08 X Quarter 4	–0.078***	(0.011)	–0.018	(0.016)	–0.307***	(0.077)	–0.022	(0.017)
Sample size	30,823		30,803		12,779		30,827	

Source: Authors' Calculation based on PSLM 2005-06 and 2007-08
Note: Variables included in the regression but not presented are the household heads' gender, marital status, age, and education level; household size; number of female and male household members between zero and five years old, six and fifteen years, sixteen and fifty-five years, and fifty-six years or older; and district indicators. Robust standard errors are in parentheses. The incremental effect at the mean is reported for the probability of having positive caloric availability from self-production. (***) significant at 1% level, (**) significant at 5% level, (*) significant at 10 % level.

To better understand the mechanisms through which households reduced average caloric consumption, we analyze caloric availability from purchased food and from self-production. Surprisingly, there is relatively little change in caloric availability from purchased foods, even when the food price increased dramatically in the first two quarters of 2008. Caloric availability from purchases is significantly lower (3 percent lower) in the first quarter of 2008 but not in any other quarter. Strikingly, the caloric availability from self-produced foods decreased dramatically. In the first and second quarters of 2008, households that consumed food they produced reported obtaining about 30 percent fewer calories from this source than in the equivalent period in 2006. This finding is intriguing because the incidence of caloric consumption from self-production did not change; households were no less likely to consume any calories from home production during the crisis quarters, as seen in the probit results in the last column of the table. This result implies that households may have preferred to sell the food they produced rather than to consume it in order to reap the income gains from higher food prices. Further analysis on caloric availability will explore this possibility.

4.1.2. Urban and Rural Differences

As suggested by the CV results for self-production, urban and rural households may have different strategies for coping with the food crisis, given that rural households have greater access to resources for producing their own food. If their access indeed has a protective effect, the implications for social protection policy in the wake of the crisis are clear. Table 6 repeats the caloric analysis from Table 5 but stratifies the results by urban or rural location. Total caloric availability (the first panel in the table) fell more significantly among rural households than urban households, particularly in the first two quarters of 2008. During those quarters, urban households consumed an average of 3.3 percent and 4.5 percent fewer calories, while rural households consumed 10.3 percent and 10.1 percent fewer calories. However, the sources of reduced consumption differ across rural and urban households. Calories from market purchases fell significantly in urban households in the last quarter of 2007 and second quarter of 2008, presumably reflecting food price increases. Market-purchased calories were also lower in the first quarter of 2008, but this effect is not a precise estimate. The decline in market-purchased calories likely reflects the reduction in real incomes resulting from the crisis. Rural households purchased fewer calories only in the first quarter of 2008. On the other hand, calories obtained through self-production were dramatically lower in rural areas—more than 35 percent lower in the first two quarters of 2008. The same parameters for urban households are not significantly different from zero. While the probability of any calorie intake from self-production is largely unchanged, these results may suggest that rural households focused on diverting their production from the household to the market.

Table 6. Change in Caloric Availability, Urban and Rural Households

	Log(Total caloric availability)		Log(Caloric availability from purchased food)		Log(Caloric availability from self-production)		Pr(Caloric availability from self-production>0), Probit	
Urban								
Year 07/08	0.033**	(0.014)	0.029*	(0.016)	0.193	(0.171)	–0.012*	(0.007)
Quarter 2 (Oct~Dec)	0.048***	(0.014)	0.027*	(0.016)	0.132	(0.154)	–0.011*	(0.006)
Quarter 3 (Jan~Mar)	0.038***	(0.014)	0.021	(0.016)	0.160	(0.159)	–0.011*	(0.007)
Quarter 4 (Apr~Jun)	0.047***	(0.014)	0.046***	(0.016)	0.224	(0.167)	–0.012*	(0.007)
Year 07/08 X Quarter 2	–0.048**	(0.019)	–0.038*	(0.022)	–0.093	(0.238)	–0.032***	(0.012)
Year 07/08 X Quarter 3	–0.033*	(0.019)	–0.024	(0.022)	–0.136	(0.235)	–0.006	(0.011)
Year 07/08 X Quarter 4	–0.045**	(0.019)	–0.048**	(0.022)	–0.045	(0.248)	0.003	(0.011)
Sample size	12,413		12,405		1,743		12,417	
Rural								
Year 07/08	0.048***	(0.009)	0.036**	(0.016)	0.233***	(0.053)	–0.041***	(0.015)
Quarter 2 (Oct~Dec)	0.018*	(0.009)	0.033**	(0.016)	0.008	(0.052)	–0.041***	(0.016)
Quarter 3 (Jan~Mar)	0.025***	(0.009)	0.083***	(0.016)	0.052	(0.054)	–0.041***	(0.015)
Quarter 4 (Apr~Jun)	0.014	(0.009)	0.073***	(0.016)	0.063	(0.055)	–0.040***	(0.015)
Year 07/08 X Quarter 2	–0.041***	(0.013)	–0.006	(0.022)	–0.148**	(0.076)	–0.009	(0.022)
Year 07/08 X Quarter 3	–0.103***	(0.013)	–0.039*	(0.022)	–0.355***	(0.077)	–0.019	(0.021)
Year 07/08 X Quarter 4	–0.101***	(0.013)	0.004	(0.022)	–0.356***	(0.080)	–0.049**	(0.021)
Sample size	18,410		18,398		11,036		18,410	

(Continued)

	Log(Total caloric availability)		Log(Caloric availability from purchased food)		Log(Caloric availability from self-production)		Pr(Caloric availability from self-production>0), Probit	
Rural and landless								
Year 07/08	0.050***	(0.012)	0.071***	(0.019)	0.217**	(0.092)	–0.091***	(0.019)
Quarter 2 (Oct~Dec)	0.012	(0.013)	0.035*	(0.019)	-0.020	(0.090)	–0.088***	(0.019)
Quarter 3 (Jan~Mar)	0.035***	(0.012)	0.099***	(0.018)	0.044	(0.091)	–0.089***	(0.019)
Quarter 4 (Apr~Jun)	0.034***	(0.012)	0.087***	(0.018)	0.061	(0.092)	–0.090***	(0.019)
Year 07/08 X Quarter 2	–0.014	(0.018)	–0.014	(0.026)	-0.258*	(0.134)	0.032	(0.028)
Year 07/08 X Quarter 3	–0.086***	(0.017)	–0.086***	(0.025)	-0.202	(0.131)	0.036	(0.027)
Year 07/08 X Quarter 4	–0.082***	(0.017)	–0.066***	(0.025)	-0.140	(0.133)	0.033	(0.027)
Sample size	11,158		11,149		4,230		11,158	
Rural with access to land								
Year 07/08	0.048***	(0.013)	0.002	(0.022)	0.154***	(0.048)	0.026***	(0.009)
Quarter 2 (Oct~Dec)	0.023*	(0.013)	0.063***	(0.022)	-0.057	(0.048)	0.021***	(0.007)
Quarter 3 (Jan~Mar)	0.035***	(0.013)	0.037	(0.023)	0.109**	(0.050)	0.020***	(0.006)
Quarter 4 (Apr~Jun)	0.028**	(0.014)	–0.024	(0.023)	0.149***	(0.051)	0.022***	(0.007)
Year 07,08 X Quarter 2	–0.063***	(0.018)	–0.042	(0.032)	-0.001	(0.069)	–0.018	(0.015)
Year 07,08 X Quarter 3	–0.124***	(0.019)	–0.062*	(0.033)	-0.293***	(0.071)	–0.002	(0.016)
Year 07,08 X Quarter 4	–0.117***	(0.020)	–0.002	(0.034)	-0.235***	(0.075)	–0.039**	(0.016)
Sample size	7,252		7,249		6,806		6,930	

Note: Variables included in the regression but not presented are the household heads' gender, marital status, age, and education level; household size; number of female and male household members between zero and five years old, six and fifteen years, Sixteen and fifty-five years, and fifty-six years or older; and dummies for districts. Robust standard errors are in parentheses. Marginal effect is reported for the probability of having positive caloric availability from self-production. The incremental effect at the mean is shown. (***) significant at 1% level, (**) significant at 5% level, (*) significant at 10 % level. Household is defined to have access to land if it owned, rented, or sharecropped agricultural land.

During the food price crisis, rural households consumed much less of the food they produced. Although one explanation is that they may have diverted food from consumption to sale, another possible explanation is that wheat production fell, either because of a production constraint or the increasing opportunity cost of producing something else. Table 7 shows cropping patterns during the two survey rounds. It indicates the relative likelihood that a household will report producing a given crop in the second survey round compared to the first.

Table 7. Crop Production

	Pr(Producing crop), Probit		Log(Amount harvested, kg)	
Wheat: Year 07/08	-0.064***	(0.007)	0.088***	(0.028)
Cotton: Year 07/08	-0.042***	(0.005)	-0.027	(0.056)
Sugarcane: Year	0.007**	(0.003)	0.080	(0.100)
Rice: Year 07/08	-0.011**	(0.005)	-0.064	(0.051)

Source: Authors' Calculation based on PSLM 2005-06 and 2007-08
Note: Variables included in the regression but not presented are the household head's gender, marital status, age, and education level; household size; number of female and male household members between zero and five years old, six and fifteen years, sixteen and fifty-five years, and fifty-six years old or older; and dummies for districts. Robust standard errors are in parentheses. Marginal effect is reported for the probability of producing crop. The incremental effect at the mean is shown. (***) significant at 1% level, (**) significant at 5% level, (*) significant at 10 % level.

The results show that rural households were 6 percent less likely to report producing wheat, 4 percent less likely to report producing cotton, and 1 percent less likely to report producing rice. On the other hand, households were 1 percent more likely to report producing sugarcane. This result is consistent with the changes in agricultural production reported in the Pakistan Economic Survey, 2007–08; farmers shifted from growing wheat and cotton to sugarcane because of relatively high sugarcane prices, elevated fertilizer prices, and the lack of irrigation water during the rabi growing season (Ministry of Finance 2008).[13]

However, the implications of this shift for farm income are unclear. The income for households that continued producing wheat grew 9 percent more, on average, than in the previous period. The increase in wheat production is indicated in the second column of Table 7, which shows results of the regression of the quantity of crops produced (conditional on growing a positive amount) on the period indicated (Year 2007–08).

13. Pakistan has two crop seasons. Kharif begins in April–June (sowing) and ends in October–December (harvest). Rabi begins in October–December (sowing) and ends in April–May (harvest). Kharif crops include rice, sugarcane, and cotton; rabi crops include wheat, gram (pulses), and tobacco (Ministry of Finance 2008).

Further analysis is required, but one conclusion is that shifting agricultural patterns alone cannot explain a mean 30 percent reduction in calories from self-produced food. If real incomes were severely affected by changes in crop choice, we would expect to observe a decline in calories through market purchases, but rural households reported no such decline.

The analysis of caloric availability from different sources reveals that food price increases affected not only total calorie intake but its composition. Table 8 presents changes in caloric availability by type of commodity. The largest price increases were for grain, especially wheat, and grain saw the largest declines in overall consumption. On average, households consumed 10 or 11 percent fewer calories from grain in 2008 than during the equivalent period in 2006. Urban households consumed less grain, but the declines among rural households were particularly steep. Rural households reported consuming 13 and 14 percent fewer calories from grain during the two crisis quarters of 2008 because they had cut back on consuming their own production.

Urban households report consuming fewer calories from vegetables and fruits, indicating that overall food consumption was declining for these households as their real income declined. Rural households do not report a similar decline, which one would expect if they had experienced a decline in real income and reduced consumption across a spectrum of foods. Rural households may not have been as badly off as urban households during the crisis, even though they consumed less of the food they produced. Presumably the income gains from agricultural sales offset the caloric decline to some degree.

Table 8. Dietary Changes

	All		Urban		Rural	
Log(caloric availability from grain)						
Year 07/08	0.012	(0.009)	0.005	(0.015)	0.017	(0.011)
Quarter 2 (Oct~Dec)	0.026***	(0.009)	0.056***	(0.015)	0.006	(0.011)
Quarter 3 (Jan~Mar)	0.045***	(0.009)	0.082***	(0.015)	0.021*	(0.011)
Quarter 4 (Apr~Jun)	0.046***	(0.009)	0.079***	(0.015)	0.024**	(0.011)
Year 07/08 X Quarter 2	–0.039***	(0.013)	–0.037*	(0.022)	–0.045***	(0.015)
Year 07/08 X Quarter 3	–0.104***	(0.013)	–0.073***	(0.021)	–0.128***	(0.015)
Year 07/08 X Quarter 4	–0.110***	(0.013)	–0.061***	(0.022)	–0.144***	(0.015)
Log(caloric availability from vegetables and fruit)						
Year 07/08	0.006	(0.011)	0.044**	(0.018)	–0.018	(0.014)
Quarter 2 (Oct~Dec)	0.074***	(0.011)	0.083***	(0.018)	0.067***	(0.014)
Quarter 3 (Jan~Mar)	0.095***	(0.011)	0.088***	(0.018)	0.102***	(0.014)
Quarter 4 (Apr~Jun)	0.072***	(0.011)	0.080***	(0.018)	0.068***	(0.014)
Year 07/08 X Quarter 2	–0.019	(0.016)	–0.068***	(0.025)	0.016	(0.020)
Year 07/08 X Quarter 3	0.000	(0.016)	–0.011	(0.025)	0.003	(0.020)
Year 07/08 X Quarter 4	–0.036**	(0.016)	–0.068***	(0.025)	–0.016	(0.020)
Log(caloric availability from other foods)						
Year 07/08	0.081***	(0.009)	0.080***	(0.014)	0.081***	(0.011)
Quarter 2 (Oct~Dec)	0.015*	(0.008)	0.011	(0.014)	0.017	(0.011)
Quarter 3 (Jan~Mar)	0.006	(0.008)	0.002	(0.014)	0.010	(0.011)
Quarter 4 (Apr~Jun)	–0.004	(0.008)	0.002	(0.014)	–0.008	(0.011)
Year 07/08 X Quarter 2	–0.023*	(0.012)	–0.029	(0.019)	–0.019	(0.015)
Year 07/08 X Quarter 3	–0.049***	(0.012)	–0.018	(0.019)	–0.069***	(0.015)
Year 07/08 X Quarter 4	–0.022*	(0.012)	–0.027	(0.019)	–0.018	(0.015)
Log(caloric availability from wheat)						
Year 07/08	0.018*	(0.009)	0.000	(0.015)	0.029*	(0.011)
Quarter 2 (Oct~Dec)	0.012	(0.009)	0.033**	(0.015)	–0.002**	(0.011)
Quarter 3 (Jan~Mar)	0.040***	(0.009)	0.066***	(0.015)	0.023**	(0.011)
Quarter 4 (Apr~Jun)	0.046***	(0.009)	0.069***	(0.015)	0.029*	(0.011)
Year 07/08 X Quarter 2	–0.031**	(0.013)	–0.026	(0.022)	–0.038***	(0.016)
Year 07/08 X Quarter 3	–0.110***	(0.013)	–0.059***	(0.022)	–0.145***	(0.016)
Year 07/08 X Quarter 4	–0.096***	(0.013)	–0.041*	(0.022)	–0.132***	(0.016)

Note: Variables included in the regression but not presented are the household heads' gender, marital status, age, and education level; household size; number of female and male household members between zero and five years old, six and fifteen years, sixteen and fifty-five years, and fifty-six years or older; and dummies for districts. Robust standard errors are in parentheses. Marginal effect is reported for the probability of having positive caloric availability from self-production. (***) significant at 1% level, (**) significant at 5% level, (*) significant at 10 % level.

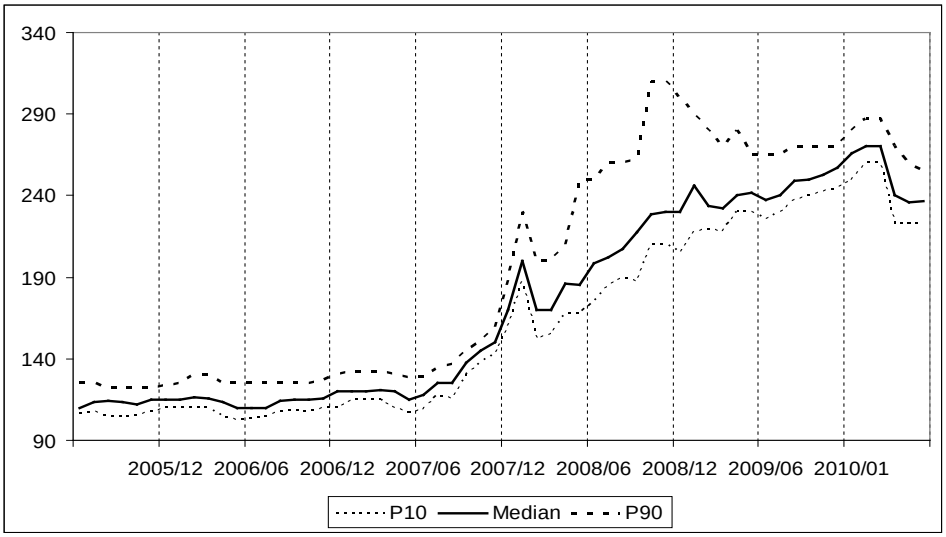
4.2. The Wheat Price and Changes in Caloric Availability Over 2008-10

4.1.1. The Changes in Caloric Availability

The previous section showed how caloric availability changed from 2005 through 2008. The analysis in this section explores how caloric availability changed as wheat prices continued to rise between 2008 and 2010.

The wheat price increased dramatically during 2008 and continued to increase through much of 2010, but the price changes were much more dramatic in some districts than others. Figure 6 depicts the time path of district wheat prices at the median, at the 10th percentile (p10), and at the 90th percentile (p90).[14] This figure shows how the regional gap in wheat prices has widened since 2008 when the wheat price began its sharp climb. We use the geographic variation in wheat prices over time to identify how rising wheat prices may have affected the welfare of individual households (measured in caloric availability), as well as the coping mechanisms—such as sales of assets—they may have used to smooth consumption.

Figure 6. Wheat Price Trend and Geographical Variations, June 2005 to June 2010



Source: Authors' Calculation based on retail price of wheat in 35 urban cities

Table 9 contains the elasticity estimates for wheat prices in relation to caloric availability. For households without access to agricultural land in 2008, elasticity is estimated to be 0.02 yet not statistically significant (first row of the first column, Table 9). On the other hand, among households with access to agricultural land in 2008, the elasticity estimate increases by 0.117 and is statistically significant. These point estimates imply that the 40

14. Ten percent of districts are at or below the 10th percentile price level, and 90 percent of districts are at or below the 90th percentile price.

percent increase in wheat price observed at the median over 2008–10 resulted in a 5 percent higher caloric availability for households with access to land compared to households without access.

Similar to the finding in the cross-sectional analysis, this analysis shows that households with access to land consumed less of their own production and purchased more of their food. A 40 percent rise in the wheat price causes these households to consume 25 percent more calories from the market and 54 percent fewer calories from their own production (if any). Compared to households without access to land, these households are 13 percent less likely to consume any self-produced food. Both urban and rural households exhibit similar patterns, yet the estimates for the rural households are larger and more precise.[15] Results from the cross-sectional analysis and panel analysis consistently indicate that when food prices rise dramatically, agricultural households generate income by selling grain or other staple foods and at the same time buy more food from the market.

Table 9. Total Change in Caloric Availability, 2008–10, Household Fixed Effect

	Log(Total caloric availability)		Log(Caloric availability from purchased food)		Log(Caloric availability from self-production)		Pr(Saloric availability from self-production>0), LPM	
All								
Log(Wheat Price)	0.019	(0.016)	–0.156***	(0.039)	1.746***	(0.294)	0.136***	(0.035)
Log(Wheat Price) X Access to Land in 2008	0.117***	(0.030)	0.616***	(0.043)	–1.349***	(0.217)	–0.326***	(0.039)
Sample size	12,911		12,905		4,641		12,911	
Urban								
Log(Wheat Price)	0.006	(0.025)	–0.016	(0.030)	0.217	(0.408)	0.025	(0.024)
Log(Wheat Price) X Access to Land in 2008	0.074	(0.105)	0.680***	(0.126)	–0.658	(0.582)	–0.595***	(0.102)
Sample size	4,971		4,967		670		4,971	
Rural								
Log(Wheat Price)	0.032	(0.021)	–0.219***	(0.034)	1.126***	(0.206)	0.068**	(0.032)
Log(Wheat Price) X Access to Land in 2008	0.111***	(0.033)	0.699***	(0.052)	–1.488***	(0.239)	–0.318***	(0.049)
Sample size	7,940		7,938		3,971		7,940	

Source: Authors' Calculation based on PSLM 2008 and 2010 Panel

Note: Variables included in the regression but not presented are the household head's gender, age, and education level and the number of female and male household members between zero and five years old, six and fifteen years, sixteen and fifty-five years, and fifty-six years or older. (***) significant at 1% level, (**) significant at 5% level, (*) significant at 10 % level.

15. This difference arises largely because of the relative size of the two populations: 32 percent of rural households have access to agricultural land, whereas only 5 percent of urban households have access.

Changes in the wheat price have had a differential impact on diets in urban and rural households and on households with and without access to agricultural land (Table 10). Unlike rural households, urban households substituted other foods for grain as the wheat price increased, but rural households with access to land witnessed a significant increase in the calories available from grain. For all households, especially those in urban areas, the higher wheat price significantly reduced consumption of animal products (2.7 percent for a 40 percent increase in the wheat price). In contrast, calories obtained from vegetables, fruit, and other foods (notably cooking oil) increased substantially. Consistent with the findings from the cross-sectional data, as the wheat price rises, households without access to land substitute vegetables[16] or other relatively cheaper foods for wheat or grain. Again, if households had access to agricultural land in 2008, they tended to consume more calories from vegetables and other sources as wheat prices rose. They may not have substituted those foods for grain, given that their grain consumption increased, probably owing to general income gains in regions where wheat price increases were particularly large. [17]

Table 10. Dietary Changes, 2008–10, Household Fixed Effect

	All		Urban		Rural	
Log(caloric availability from grain)						
Log(Wheat Price)	–0.014	(0.021)	–0.058*	(0.034)	0.028	(0.028)
Log(Wheat Price) X Access to Land in 2008	0.122***	(0.040)	0.112	(0.144)	0.084**	(0.043)
Log(caloric availability from animal products)						
Log(Wheat Price)	–0.068**	(0.031)	–0.092**	(0.043)	–0.051	(0.043)
Log(Wheat Price) X Access to Land in 2008	–0.033	(0.058)	–0.434**	(0.183)	–0.015	(0.067)
Log(caloric availability from vegetables and fruit)						
Log(Wheat Price)	0.073***	(0.027)	0.094**	(0.042)	0.053	(0.035)
Log(Wheat Price) X Access to Land in 2008	0.115**	(0.050)	0.057	(0.176)	0.142***	(0.054)
Log(caloric availability from other)						
Log(Wheat Price)	0.059***	(0.019)	0.046	(0.030)	0.067***	(0.025)
Log(Wheat Price) X Access to Land in 2008	0.167***	(0.036)	0.222*	(0.125)	0.159***	(0.039)

Note: Variables included in the regression but not presented are the household head's gender, age, and education level and the number of female and male household members between zero and five years old, six and fifteen years, sixteen and fifty-five years, and fifty-six years or older. (***) significant at 1% level, (**) significant at 5% level, (*) significant at 10 % level.

16. The grain price increased by 30 percent while the vegetable and fruit price increased by 24 percent from January to December 2008, based on national average prices of each item and weights for the consumer price index (0.2 for grain and 0.13 for vegetables and fruit).

17. Grain consumption accounts for 52 percent of calories consumed, animal products for 12 percent. vegetables and fruit for 5 percent, and other foods for 31 percent (in the 2008 data).

Access to agricultural land may mitigate the severity of rising food prices. Other assets, however, may also help households cope. Table 11 explores changes in holdings of these other assets in relation to local wheat price increases (see also Appendix Table 1). Among households without access to agricultural land, ownership of nonproductive asset such as financial assets and precious metals (especially gold) falls as wheat prices rise.[18] This finding suggests that an important coping mechanism for these households, until this point in the food crisis, was to divest themselves of their nonproductive assets. Households with access to agricultural land were more likely to draw down financial assets other than precious metals, suggesting that their access to land may have buffered their losses to some extent. Regardless of their access to agricultural land, however, households in areas with higher wheat prices gave up significantly more assets than households in areas where prices did not rise as much.

With respect to productive agricultural assets, rural households without access to land acquired more livestock as wheat prices rose. Households with land sold off their livestock, presumably to dedicate more resources to crop production.

Table 11. Changes in Assets, 2008–10 Panel Data, Household Fixed Effect

	All		Urban		Rural	
Pr(Financial Asset>0)						
Log(Wheat Price)	–0.149***	(0.020)	–0.168***	(0.032)	–0.135***	(0.027)
Log(Wheat Price) X Access to Land in 2008	–0.086**	(0.038)	–0.198	(0.135)	–0.086**	(0.042)
Pr(Precious Metal Own)						
Log(Wheat Price)	–0.468***	(0.025)	–0.422***	(0.038)	–0.502***	(0.034)
Log(Wheat Price) X Access to Land in 2008	0.125***	(0.047)	0.113	(0.159)	0.162***	(0.052)
Pr(Livestock Ownership)						
Log(Wheat Price)	0.130***	(0.017)	0.006	(0.013)	0.233***	(0.027)
Log(Wheat Price) X Access to Land in 2008	–0.331***	(0.031)	–0.515***	(0.055)	–0.408***	(0.042)

Source: Authors' Calculation based on PSLM 2008 and 2010 Panel
Note: Variables included in the regression but not presented are the household head's gender, age, and education level and the number of female and male household members between zero and five years old, six and fifteen years, sixteen and fifty-five years, and fifty-six years or older. (***) significant at 1% level, (**) significant at 5% level, (*) significant at 10 % level.

18. In 2008, 19 percent of households owned financial assets, 69 percent owned precious metals, and 15 percent owned livestock.

5. CONCLUSIONS AND POLICY IMPLICATIONS

This note has examined how the global and domestic food crisis affected Pakistani household welfare in terms of baseline consumption value and calorie intake. Rising global food prices affected Pakistani households throughout 2008; compensating variations began to rise dramatically at the start of 2008 and had doubled by the end of the year. This outcome demonstrates that ex ante estimates of welfare losses will depend on when the effect is measured (as well as the response of incomes over the period). Over time, the food price crisis expanded the gap between Pakistan's poor and nonpoor populations, indicating that the effects of such a crisis on income distribution can be underestimated if compensating variations are measured at only one point in time.
Second, while differences in welfare effects between rural and urban households were minor, the compensating variation from the food crisis in Pakistan differed greatly across provinces. The large regional difference in welfare effects arising from the food crisis is greater than the mean gap between the poor and nonpoor in Pakistan.

One of the limitations of the compensating variation method is that it forecasts distributional effects only on the basis of consumption levels before the crisis. It is a measure of possible impact, but it does not account for potential shifts in income that can mitigate the adverse consequences of rapid price changes. For this reason, we used a regression method to understand how the food crisis affected caloric availability. Caloric availability started to decline as early as the last quarter of 2007, and total calorie intake decreased by 8 percent from April 2008 to June 2008, compared to the period before the crisis.

This decline in caloric availability supports the predictive results from the compensating variations. Both the compensating variation and caloric analyses show that urban households are unambiguously worse off because of the crisis. They would require a compensating variation of at least 35 percent of their precrisis expenditures to maintain their baseline level of utility, and poor urban households would require compensated income of 45 percent to maintain consumption. The effects on urban households are also seen in their caloric consumption patterns. Urban households consumed significantly fewer calories—about 5 percent fewer on average. This decline appears to be a direct result of rising food prices, because it derives from fewer market purchases of various categories of food.

Analyzing the changes in calorie intake by source gives a better understanding of the protective role played by agricultural production among rural households. The compensating variation calculations that take self-production into account predicted that rural households would not be as adversely affected by the crisis. Indeed, although caloric availability declined for rural households, the calories obtained through market purchases remained largely unchanged over the crisis. This result suggests that the decline in real income was not as severe for rural households compared to urban households. Although calories from food produced by the household declined significantly, the decline does not appear to result from a dramatic reduction in agricultural output. Perhaps agricultural

households sought to capitalize on the relatively higher prices for agricultural goods, although more work is needed before this conclusion can be drawn with confidence.

An analysis of the panel data from 2008–10 further emphasizes the protective role of access to land in the midst of the food crisis. Regions with higher local prices for wheat, the single most important staple food in Pakistan, exhibited a clear divergence in caloric availability between households having access to agricultural land and those lacking access. The higher wheat prices induced substantial increases in caloric availability among households with access to land, indicating gains in real income for these households. The drawdown of assets also enabled households, especially those with no access to land, to cope with rising food prices during the 2008–10 period.

In summary, cumulative welfare losses during the food price crisis in Pakistan widened the gap between the poor and nonpoor and exacerbated inequalities across provinces—a conclusion reinforced by measured reductions in caloric availability. The analysis of changes in calorie intake by source provides a better understanding of how the capacity to engage in food production can protect rural households from the worst impacts of rising food prices.

These findings highlight the significant contribution that BISP could make in extending social protection in the event of a new food price crisis and suggest strategies to improve the identification of beneficiaries. The poverty scorecard, BISP's primary instrument for identifying its beneficiaries, helps to identify poor and vulnerable segments of the population, based on national census data. In the event of a new food price crisis, the government could raise the poverty cut-off score or complement BISP's current targeting scheme with more categorical targeting strategies. For example, the government could identify households at different poverty thresholds that lack access to land. Simulations using these data could provide information for designing a complementary social protection program, within the allocated budget, to minimize the damage of escalating food prices on the most needy and vulnerable families.

Aside from cash transfer programs such as BISP, the government could consider supply interventions that make food more accessible, particularly for households without access to agricultural land. For example, the government maintains networks of utility stores to sell discounted food but places no limitations on who can purchase that food. The government may want to consider targeting eligibility to purchase discounted food to poorer segments of the population, identified on the basis of the poverty scorecard census.

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APPENDIX

Appendix Table 1: Summary Statistics, Quarter of Interview

	Jul~Sep		Oct~Dec		Jan~Mar		Apr~Jun	
	2005	2007	2005	2007	2006	2008	2006	2008
Caloric availability								
Total caloric availability, per capita	2,422	2,508	2,462	2,462	2,471	2,367	2,593	2,392
Caloric availability from purchased food, per capita	1,899	1,948	1,920	1,956	1,965	1,964	1,990	2,024
Caloric availability from self-produced food, per capita	447	473	462	429	439	353	397	303
Pr(consuming self-produced food)	47%	44%	47%	42%	42%	37%	39%	33%
Diet								
Caloric availability, grain	1,357	1,374	1,383	1,333	1,389	1,268	1,407	1,271
Caloric availability, animal products	293	326	302	321	311	311	295	303
Caloric availability, vegetables and fruit	126	119	135	127	131	134	125	139
Caloric availability, other food	647	689	641	681	640	655	767	678
Caloric availability, wheat	1,150	1,179	1,154	1,144	1,182	1,076	1,191	1,093
Agricultural activity								
Having access to land	29%	28%	30%	27%	26%	21%	23%	18%
Wheat producer	26%	23%	26%	23%	23%	18%	19%	16%
Cotton producer	8%	6%	8%	6%	7%	4%	5%	4%
Sugarcane producer	3%	4%	3%	3%	3%	4%	2%	2%
Sample size	**3,888**	**3,790**	**3,847**	**3,708**	**3,841**	**4,106**	**3,835**	**3,889**

Source: PSLM 2005–06 and 2007–08, by quarter of interview

Appendix Table 2: Own and Cross-Price Elasticities of Aggregate Goods, 2007–08

	Milk	Meat	Fruit	Vegetables	Spices	Wheat	Rice	Cereals	Pulses	Oil	Other	Non-Food
Milk	–0.792	–0.155	0.010	0.028	–0.069	–0.106	-0.227	0.055	–0.277	0.221	–0.031	–0.404
Meat	–0.017	–0.904	0.050	0.120	0.164	0.033	0.089	0.065	0.533	–0.661	–0.050	–0.275
Fruit	0.081	–0.127	–0.696	0.358	–0.226	0.283	-0.069	0.129	0.115	–0.753	–0.097	–0.084
Vegetables	–0.106	–0.021	–0.039	–0.462	0.574	0.052	-0.012	–0.055	–0.147	–0.039	–0.017	–0.087
Spices	0.060	0.110	0.054	–0.021	–1.213	–0.193	0.157	–0.056	0.208	–0.178	0.025	–0.099
Wheat	–0.143	0.336	–0.066	–0.017	–0.280	–0.430	0.213	0.056	–0.196	–0.141	–0.001	–0.239
Rice	0.010	–0.050	0.010	–0.496	1.468	0.177	-1.177	–0.410	–0.316	0.353	0.261	–0.100
Cereals	0.521	0.051	0.201	0.507	–0.349	0.133	-0.316	–0.405	0.257	–0.259	–0.117	–0.053
Pulses	0.022	–0.164	0.033	0.213	0.530	0.244	0.233	–0.124	–0.289	–0.028	–0.057	–0.189
Oil	–0.094	0.002	0.007	–0.002	0.165	–0.062	-0.044	–0.060	–0.154	–0.520	–0.028	–0.030
Other	0.513	0.244	0.620	0.052	0.422	0.508	0.092	0.480	0.416	–0.062	–0.954	0.072
Nonfood	0.008	–0.015	–0.012	–0.018	–0.037	–0.048	0.006	–0.002	0.007	0.004	0.002	–0.096

Source: Authors' Calculation based on PSLM 2007-08

Appendix Table 3: Share of Caloric Availability from Different Sources, 2005–06

	Urban		Rural	
Calories from grain (%)	51.0	(13.0)	58.4	(10.9)
Calories from animal products (%)	14.7	(8.3)	12.1	(7.5)
Calories from vegetables and fruit (%)	6.2	(5.6)	4.7	(3.5)
Calories from other foods (%)	28.1	(7.5)	24.8	(7.0)
Sample size	**6,213**		**9,198**	

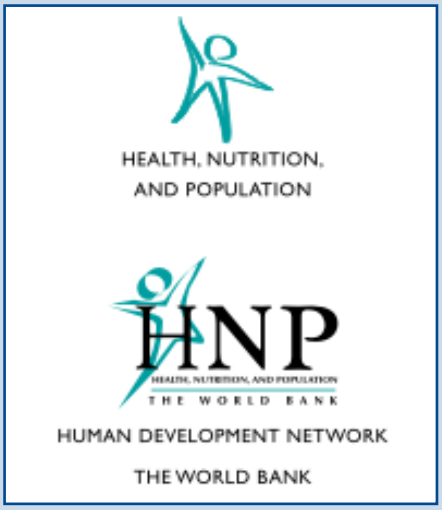
Source: Authors' Calculation based on PSLM 2005-06
Note: Standard deviation is in parentheses.

Appendix Table 4: Food Aggregates and Individual Items (PSLM)

Food aggregates	Recall period	Individual items
1. Dairy product	14 days	Milk (fresh and boiled)
	14 days	Milk (packed by milk plants)
	14 days	Milk, powdered (for adults and children)
	14 days	Curd/yoghurt, *lassi* (buttermilk)
	14 days	Butter, margarine, cream, cheese
	14 days	Other (e.g., *ferni*, *kheer*, condensed milk, ice cream, *kulfi*)
2. Meat	14 days	Beef
	14 days	Mutton
	14 days	Chicken meat (fresh, frozen) / Other poultry birds (e.g., duck, quail, turkey)
	14 days	Eggs
	14 days	Fish (fresh, frozen, dried)/ Prawns, shrimps, or crabs (fresh, frozen, canned)
3. Fruit	14 days	Banana
	14 days	Citrus fruit (e.g., *mosummi*, *malta*, *kinno*)
	14 days	Apple
	14 days	Dates
	14 days	Grapes
	14 days	Mango
	14 days	Other fresh fruit (e.g., pomegranate, apricot, jamons, lemon, pear, peach, plum, papaya, melon, *garma*, *sarda*
	14 days	Canned fruit
	14 days	Raisin, dates, apricot (dried), other (e.g., almond, walnut,*chilgoza*, pistachio, peanuts, aniseed, cashew, coconut, sesame seeds)
4. Vegetables	14 days	Potato
	14 days	Onion
	14 days	Tomato
	14 days	Cabbage, cauliflower
	14 days	Karaila, ladyfinger, *brinjal*, cucumber

Food aggregates	Recall period	Individual items
	14 days	*Tinda*, pumpkin, bottle gourd
	14 days	Radish, turnip, carrot
	14 days	Peas, *moongra*
	14 days	Other (e.g., green chillies, *tural*, lettuce, *kulfa*)
	14 days	Canned vegetables
5. Spices	14 days	Salt simple (rock and sea)
	14 days	Salt (iodized)
	14 days	Chillies, red
	14 days	Turmeric, coriander seed
5. Spices Continued	14 days	Ginger
	14 days	Garlic
	14 days	Cinnamon, caraway, cardamom, *salan masalah* /Other spices (e.g., licorice root, cumin seeds, black pepper, cloves, mixed condiments)
	14 days	Sugar (*desi* or milled)
	14 days	*Gur* / *Shakkar*
	14 days	Honey (fresh or processed)
	14 days	Confectionery (e.g., toffee, chocolate, chewing gum)
	14 days	*Barfi*, *jaleebi*, *halwa* , and other sweetmeats
	14 days	Glucose, Energile, and so forth
6. Wheat	1 month	Wheat and wheat flour
7. Rice	1 month	Rice and rice flour
8. Cereals	1 month	*Suji*, *maida*, *besan*
	1 month	Other cereal products (e.g., vermicelli, corn flakes, noodles, macaroni, spaghetti)
9. Pulses	1 month	Gram whole (black and white)
	1 month	*Dal chana*
	1 month	*Mash*
	1 month	*Moong*

Food aggregates	Recall period	Individual items
	1 month	*Masoor*
	1 month	Other (e.g., *arhar*, chick/pigeon/garden peas, sunflower, soybean)
10. Oil	1 month	*Desi ghee*
	1 month	Vegetable *ghee*
	1 month	Cooking oils, other oils, and fats
11. Other foods	14 days	Carbonated beverages
	14 days	Squashes and Syrups (not medicated)
	14 days	Sugarcane juice, other fresh juices, fruit juices (packed), mineral water, and so forth
	14 days	Readymade meals, snacks, tea, ice cream, drinks, instant foods
	1 month	Tea (black, green, loose and packed)
	1 month	Coffee, other (e.g., Ovaltine, Horlick's, Milo, Complan)
	1 month	Biscuits (sweet and savory)
	1 month	Bread, bun, *sheermal*
	1 month	*Tandoori roti, nan, kulcha, puri, paratha*
	1 month	Other baked or fried products (e.g., *pakoras, samosa, qatlama*, popcorn), cake, *bakerkhani*, pastries, patties)
	1 month	Jams, marmalades/ tomato ketchup/pulp/ pudding, jelly, pickles, *chatni*, vinegar, yeast, Ice, and so forth
	1 month	Food and grain milling/grinding charges



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