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The Effects of 2016-2017 Rice Price Increase on Household Welfare and Poverty in Rural Bangladesh

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1. Introduction

Rice is Bangladesh's main staple food for the 163 million people of the country. Rice provides two-thirds of the calorie needs and half the protein consumption of the nation. The per capita consumption of rice in Bangladesh is the largest among all other countries of the world. The country meets its rice demand mainly through its own production. Rice cultivation accounts for 48% of total rural employment. A majority of households have a high consumption share of rice associated with a very low cross-price elasticity (Hasan 2016). Therefore, rice price fluctuations are a great interest to both consumers and producers. The surge in global food prices in 2007-2008 that include rice price spike has hurt low-income households of the lower-income countries around the world including Bangladesh. The rice price increase in 2007-2008 raises the headcount poverty of Bangladesh (Hasan 2016). Since June 2016, rice price in Bangladesh has started to increase sharply and remained high until this April 2018 (figure 1). The retail price increases by about 50%. This increase in rice price is likely to again hurt the low-income households of the countries and is likely to increase poverty rate. This will pose a serious challenge in achieving the goal 1 of Sustainable Development Goals (SDGs)¹.

The impact of the increase in rice price on households' welfare will depend on the net position of the households as buyer or seller of the rice. The increase will benefit households who are net rice sellers and hurt those who are net rice buyers. And this is likely to hold for both urban and rural households. The overall impact will mainly depend on two factors such as the proportion of net rice sellers in total households and the proportion of net rice buyers in total households. If the gains to poor net sellers outweigh the adverse impacts on poor consumers, then the net impact of rice price will lower the number of poor households. Thus, the objective of this paper is to investigate each of these issues and provide a comprehensive analysis of changes in household welfare and poverty in rural Bangladesh to an increase in rice price using the most recent (2015) Bangladesh Integrated Household Survey (BIHS). This study also provides regional heterogeneity of the impacts of rice price shock since price effects differ across cities or regions depending on the socioeconomic characteristic of the respective region.

¹ The core SDG indicator of the SDG goal 1 is to end poverty in all forms and dimensions by 2030 from everywhere.

Figure 1. The trend of Rice Price in Bangladesh

2. Literature Review

A large number of studies have investigated the impacts of food price changes including rice price changes on welfare and poverty using several empirical models. We discuss the findings of recent studies in this section (summaries are given in table 1). Some of these studies focus on rice price changes in Bangladesh.

Mghenyi et al (2011) estimate the effects of a large increase (25%) in maize price on household welfare and poverty using first and second-order Taylor approximation as well as a semi-parametric method nested on Speckman estimator for a sample of rural Kenyan households. The authors use a nationwide cross-sectional survey data of 2004 concentrated mainly on smallholder farm households, conducted by the Tegemeo Institute of Egerton University and Michigan State University. The authors show that a 25% arbitrary increase in maize price leads to the welfare effects ranging from -10% (loss) to 10% (gain). Producers of maize gain and consumers lose from this increase in price. On the impact on poverty, Mghenyi et al (2011) find that a number of households from net buyer group move down below poverty line and a number of households from net sellers move up. Overall, they find that the effects price of increase on poverty are not much stronger regardless of whichever poverty line is used.

Minot and Dewina (2015) examine the effects of 2007-08 maize price increase on welfare and poverty for Ghanaian households using modified method of Deaton (1989) approach. They use 2005-2006 Ghana Living Standards Survey (GLSS). They find that in the short run net buyers of maize suffer from welfare loss as maize price rises and the welfare loss is highest for poorest quintile. For poverty, they show that under proportional marketing margin. The incidence of poverty rises by 0.3 percentage point in the short run and in the long run, change in poverty is 0. Under Fixed marketing margin, the incidence of poverty falls by 0.9 (1.5) percentage point in the short (long) run. They conclude that under different marketing margins, the impact of maize price increase on poverty is different and create different implications for the different household group.

Levin and Vimefall (2015) extend the study of Mghenyi et al (2011)'s analysis by accounting for heterogeneous maize price increase. They assume consumers and producers face separate price changes and estimate the welfare effect of that changes. To carry on the analysis, they use 2005-06 Kenya Integrated Household Budget Survey (KIHBS). Their results show that welfare of net sellers and buyers' changes by 14% and -11%, respectively. The poverty rate increases by 1-3 percentage points (PP).

Balagtas et al (2014) evaluate the impact of 2007-2008 rice price increase on income and rural poverty. They exploit a longitudinal survey data available for years 1988, 2000, 2004, and 2008 to recognize household characteristics linked to poverty and market characteristics that can possibly amplify or mitigate the price effects. They find that the sharp increase in 2007-2008 price increase the headcount poverty by 12 percentage points, which means an additional 113 more million rural falls into the poverty trap.

Badaro and Traoré (2015) conduct a similar study in Burkina Faso in the context of global price rise, as they examine rice price hike on poverty and income inequality. In order to calculate the effect of rice price increase on real income, they use the concept of compensating variation(CV), originally developed by Deaton and Muellbaur(1980). They use a cross-sectional named Living Standard Survey, conducted over the period 2002-2003. They find that households lose as rice price goes up and the loss of the households is more severe for dwellers in urban areas (-5.7% as compared to -2.2% for rural). Poverty rate rises in short run but mitigates in the long run. Poverty shows an upward trend ranging from 2.2-2.6 pp in the short run. They also find that higher price increases inequality.

Hasan (2016) analyze the distributional effects of sharp rice price increase (50%) on welfare and poverty. His work is similar in methodology as Mghenyi et al (2011) and Badaro and Traoré (2015). The outcome variables resemble those used in previous studies. One improvement comes from using consumption in lieu of income as welfare indicator, given income may be subject to measurement error. Following Foster (1984), they generate a measure of poverty, and poverty is measured based on before and after; actual and counterfactual consumption. Data used in this study comes from 2010 Bangladesh Household Income and Expenditure Survey (HIES). Their estimates of the first-order Taylor approximation show an overestimation of the welfare effects when price shock persists for longer time, showing a value of 6% loss. The second-order expansion allows for adjustment in demand-supply and reverses the scenario by demonstrating a welfare gain of 2.8%. Not surprisingly, net buyers are among the losers from price rise. As per the first order poverty dominance, headcount ratio (HCR) falls for districts the majority of households on the production side and the vice-versa. In terms of second-order dominance to calculate headcount ratio under official definition of the poverty line, HCR rises indiscriminately for producers and consumers. This pins down the fact that most of the poor households are already in borderline when rice price rises are pushed below the poverty line raising HCR (Hasan, 2016).

Table 1. Summary of findings regarding welfare and poverty effects of food price change

Study	Country/ Region	Context	Method(s) employed and data type	Findings
Mghenyi et al (2011)	Rural Kenya	25% arbitrary increase in maize price	1.Second-order Taylor approximation 2.Semi-parametric method(Speckman estimator) to analyze the relationship between household income and Welfare *Cross-sectional data(2004 Household survey)	Proportional welfare effects ranging from -10% to 10%. Winners: Net producers Losers: Net consumers Poverty: PHC increases by an insignificant unit; however marginal people experience greater loss.
Minot and Dewina (2015)	Ghana	2007-08 maize price increase	1. Expand Deaton's expression to compute Compensating variation (CV). 2. Use four different simulations with varied marketing margins both in short and long run. *2005-2006 Ghana Living Standards Survey (GLSS)	NBR: Negative as Ghana is the importer of Maize in the global market. Movement of Poverty indicator is ambiguous, the percentage of incidence can move in either direction based on simulation used.
Levin and Vimefall (2015)	Kenya	Increase in Maize price	Estimate the distributional effects under different marketing margins. *2005-06 Kenya Integrated Household Budget Survey (KIHBS)	NBR (net sellers): 14% NBR(net buyers):-11% Bottom quintile is more vulnerable to poverty incidence. Studies ignoring different marketing margins might have overestimated the effects.
Balagtas et al (2014)	Bangladesh	Commodity price spike experienced in 2007-2008, impact on rice	1. Analyze household characteristics of poverty that might amplify/mitigate price shock effects. 2. Study poverty dynamics using Foster's approach * longitudinal survey data available for years 1988, 2000, 2004, and 2008	Non-farmers had lower income than farmers. Headcount index (HCI), poverty gap ratio (PCR), squared poverty gap (SPG) all fell during 1988-2004; and then rose following the price spike. Mobility matrix indicates increased downward movement.
Badaro and Traoré (2015)	Burkina Faso	The global price hike, for rice	1. Compute CV based on Deaton's approach. 2. Measure poverty based on HCI, PGR, SPG 3. income inequality captured by Gini index and Theil index * Living Standard Survey, 2002-2003.	NBR -3.3%, share of consumption in total expenditure is higher compared to the share of production in total income. Richer quintiles lose more in terms of NBR. Poverty rises in short run, the effect is mitigated in the long run. Both Gini and Theil Index reflect higher inequality.
Hasan (2016)	Bangladesh	50% increase in the price of rice	1. Take second order Taylor approximation. 2. Use consumption as a measure of welfare indicator. 3. Capture poverty from HCR. * 2010 Bangladesh Household Income and Expenditure Survey (HIES)	Positive welfare gain, though net buyers suffer welfare loss. Income groups in the middle tend to lose the most. Second-order dominance shows HCR rises for all the parties in the market.

3. Methodology and data

3.1 Welfare effects of rice price increase

We use compensating variation (CV) derived from indirect utility function to estimate the effects of price changes on household welfare. Let's denote an indirect utility function v with household income y (income other than rice production). Then, for household i , the effect of a price (p) changes on compensating variation measure of the welfare effect can be expressed as (Mghenyi et al. 2011)

$$(1) \quad V_i \left[p_i^0; y_i + \pi_i(p_i^0) \right] = V_i \left[p_i^1; (1 - m_i)[y_i + \pi_i(p_i^1)] \right]$$

where p_i^0 and p_i^1 are the initial and new higher price level, respectively; $\pi_i(p_i^0)$ is profit from rice production; m_i is the proportional reduction in income for household i required after the price change to return the household to its original level of utility.

Now, assuming households (both net producer and consumer) face the same price and price changes, then following (Mghenyi et al. 2011), we can write second-order welfare effects of price changes using a second-order Taylor series approximation of (1)

$$(2) \quad m_i \approx (s_i^s - s_i^d)\lambda - 0.5 \left[s_i^s \xi_i^{ps} - s_i^d \xi_i^{pd} \right] \lambda^2 + 0.5 \left\{ (R_i - \xi_i^{yd}) \left[(s_i^d)^2 - 2s_i^d s_i^s \right] + R_i (s_i^s)^2 \right\} \lambda^2$$

where s_i^s and s_i^d denote the share of the monetary value of rice production and rice consumption

in total income or expenditure; λ denotes $\frac{p^1 - p^0}{p^0}$; ξ_i^{ps} , ξ_i^{pd} , and ξ_i^{yd} denote the elasticity of supply, the elasticity of demand, and the income elasticity respectively; R_i denotes the household's coefficient of relative risk aversion (a measure of the curvature of the household's indirect utility function in income).

3.2 Poverty effects of rice price increase

We examine the poverty impact of rice price increase using a descriptive statistical method and a poverty measure proposed by Foster et al (1984) and Foster and Shorrocks (1988a, 1988b). In the descriptive method, we group total rural households as net sellers and net buyers. Households that are net sellers (who sell after own consumption) would benefit from the increase in price. On the other hand, net buyers (who buy rice for the consumption) would be negatively affected. The net impact depends on the distribution of net buyers and sellers among poor people households who

are already below the poverty line and close to the borderline. The steps of the descriptive method are as follows. First, we calculate the distribution of rural households as net sellers and net buyers. Second, we estimate the distribution of net sellers and buyers among poor and non-poor households using the national official upper poverty line. The upper poverty line (hereafter poverty line) per capita per month income or expenditure is Tk 2268. Third, we adjust all households (net seller and net buyer) post price shock expenditure and poverty line income and then compare the headcount rate (HCR) of poverty before and after the price increase. Last but not the least, we estimate what portion of the net sellers move out of poverty and what portion of the net buyers fall into poverty.

The poverty measure proposed by Foster et al (1984) and Foster and Shorrocks (1988a, 1988b) can be explained as follows. Let $F : R_+ \rightarrow [0,1]$ represent the distribution of ordered real incomes in a population such that $F(a)$ is the proportion of the population with income less than or equal to a . Then for some poverty line a , we use the headcount ratio:

$$(3) \quad P_1(F; a) = F(a)$$

and the per capita income gap:

$$(4) \quad P_2(F; a) = \frac{1}{a} \int_0^{F(a)} [a - F^{-1}(y)] dy$$

where P_1 is the headcount ratio (HCR) and it is just the proportion of households below a poverty line whereas P_2 or the per capita income gap is a normalized sum of income shortfalls of the poor lying below the poverty line.

3.3 Data

This study utilizes 2015 Bangladesh Integrated Household Survey (BIHS). BIHS, 2015 is a cross-sectional data and provides detailed information on household consumption, agriculture production, anthropometry, economic shocks and events, education, employment, food grain stock, and food security including many others. The sample is statistically representative at following levels: (a) nationally representative of rural Bangladesh; (b) representative of rural areas of each of the seven administrative divisions of the country: Barisal, Chittagong, Dhaka, Khulna, Rajshahi, Rangpur, and Sylhet; and (c) representative of the Feed the Future (FTF) zone of influence. This study uses a sample of 4415 rural households.

4. Empirical Results

4.1 Welfare Impact

Table 2 presents mean and standard deviation (SD) of the welfare effects of rice price changes across seven regions or divisions and for the whole country. The results of the first-order effect indicate that expect for Rajshahi division, the welfare decreases in all divisions. The second-order effects show less negative values compared to first-order effects and the effects for Rangpur division turn out positive. Overall, the impact of rice price increase on household welfare is negative.

Table 2. Impact of 50% increase in rice price on household welfare (weighted)

Region	First-order approximation		Second-order approximation		Total	
	Mean	SD	Mean	SD	Mean	SD
Barisal	-0.029	0.129	-0.014	0.146	-0.042	0.274
Chittagong	-0.044	0.054	-0.037	0.054	-0.081	0.108
Dhaka	-0.016	0.169	0.004	0.238	-0.013	0.404
Khulna	-0.026	0.104	-0.014	0.117	-0.040	0.220
Rajshahi	0.026	0.257	0.064	0.392	0.090	0.645
Rangpur	-0.007	0.179	0.015	0.227	0.009	0.405
Sylhet	-0.034	0.113	-0.021	0.139	-0.055	0.251
Bangladesh	-0.019	0.160	0.000	0.225	-0.019	0.383

Note: These estimates are based on equation (2) and assuming $\lambda = 50\%$, $\xi_i^{ps} = 0.248$, $\xi_i^{pd} = 0.45$, $\xi_i^{yd} = 0.60$ $R_i = 1$.

4.2 Poverty Impact

Figure 2 shows the distribution of net sellers and the net buyers of rice. Of the total 4415 households (HHs), only 26.07% are net sellers. This indicates that a large number of households would lose their purchasing power caused by a price hike than the gain since the number of net sellers is much fewer than the net buyers.

Now turning our analysis to the distribution of poor by net sellers and buyers, we find that about 19% of the total net sellers are poor households and about 28.5% of net buyers are poor. (figure 3) This statistic indicates that a portion or all of the 19% net sellers will move out of poverty that depends on the magnitude of the price increase. The results also indicate that households that will fall into poverty are from the 71% of the net buyers. If the number of people (seller HHs)

move out of poverty is greater than the number of people (buyer HHs) slips from the non-poor to poor, then the overall headcount poverty will decrease or vice versa. This depends on the number of people close to the borderline of poverty level income.

Figure 2. Distribution of rural households by net sellers and buyers

Figure 3. Distribution of poor (HCR) and non-poor by net sellers and net buyers before the increase of price

Note: We use 2016 national poverty line income to calculate HCR.

Estimations of the 2016-2017 rice price increase (40% for net sellers and 50% for net buyers) indicate that the effects on poverty are quite large. The HCR of poverty in rural Bangladesh increases by 5.6 percentage point from 25.28% in 2015 to 31.35% in 2016-2017 (figure 4). This result implies that more buyers fall into poverty than the sellers who move out of poverty. This is

confirmed by results of figure 5. The estimation results show that about 10% net sellers move out of poverty as against 11% increase in HCR of poverty among buyers. Since net sellers constitute only 26% of total rural households, the overall rural HCR of poverty in Bangladesh increases by 5.6 percentage point. Taking into account this increase in HCR, we calculate the number of people turns into poor for rural Bangladesh. Our estimates suggest that about 5.50 million additional people fall below poverty line because of a 50% increase in retail rice price.

Figure 4. Impact of 50% rice price increase on headcount poverty rate (HCR) in Rural Bangladesh

Note: We allow 41% increase in price for net sellers and 50% increase in price for net buyers based on the data as shown in figure 1. This increase from the survey year 2015 to 2016-2017. The percentage increase of consumer price is higher than the percentage price increase of producer or wholesale price. We use the magnitude of price transmission (1% wholesale price increase leads to 1.22% retail price increase) from <https://onlinelibrary.wiley.com/doi/pdf/10.1002/agr.2146> to calculate the retail price change. Prices vary across each household.

Figure 5. Impact of 50% increase of rice price on headcount poverty rate (HCR) by net sellers and buyers

Figure 6 shows second-degree measure of poverty effects caused by an increase in rice price as obtained estimating equations (3) and (4). The results show that poverty increases in Barishal, Chittagong, Khulna, and Sylhet division since per capita income gap is negative in most cases. The poverty rate slightly decreases or unchanged in Rajshahi, Rangpur, and Dhaka divisions.

Figure 6. Impact of 50% increase in rice price on poverty estimated using second-degree poverty dominance curves

Figure 6. Impact of 50% increase in rice price on poverty estimated using poverty dominance curves

5. Conclusions

Utilizing the most recent (2015) BIHS data, this study assesses the impact of rice price shock on the household welfare and poverty in rural Bangladesh. We find that the increase in rice price reduces the welfare of the households and increases poverty rate in rural Bangladesh. A 50% increase in retail rice price leads to a 5.6 percentage point increase in HCR of poverty in rural Bangladesh, i.e., HCR of poverty increases from 25.28% in 2015 to 31.35% in 2016-2017. This is a short-run impact of the price increase. We do not account for the increase in wage rate.

Our decomposition of total households into net sellers and net buyers reveal that households who are net buyers fall into poverty more in number than the net seller who move out of poverty. The estimation results show that about 10% net sellers move out of poverty as against 11% increase of HCR of poverty among buyers. Since net sellers constitute only 26% of total rural households, the overall HCR of poverty in rural Bangladesh increases. Taking into account this increase in HCR of poverty, we calculate the number of people fall into poverty for rural Bangladesh. We find that about 5.50 million additional people fall below poverty line because of a 50% increase in retail rice price. On the regional variation of the impact, this paper finds that except for Rajshahi and Rangpur regions, the increase in rice price reduces the welfare of the households and increases poverty rate in all other regions.

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