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The Effects of a Large Rice Price Increase on Household Welfare and Poverty in Rural Bangladesh

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Abstract

This study assesses the impact of rice price shocks on household welfare and poverty in rural Bangladesh using the first- and second-order welfare measures derived from an indirect utility function. This article contributes to this literature by accounting for the heterogeneous price increase across each household and a differential price increase for net buyers and net-sellers. By utilizing 2015 Bangladesh Integrated Household Survey (BIHS) data, this article finds that a large increase in rice price reduces the welfare of the households and increases the poverty rate in rural Bangladesh. A 35% increase in retail price and a 28.5% increase in wholesale rice prices lead to a 1.72 and 1.43 percentage points increase in the headcount rate (HCR) of poverty in rural Bangladesh estimated using the upper and lower poverty lines, respectively. The 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 moves out of poverty. The results of this study would be valuable inputs for policymakers to design policies that protect the group of households who get hurt from rice price shocks.

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1. Introduction

Rice is Bangladesh's main staple food for the 166 million people of the country[1]. Rice provides two-thirds of the calorie needs and half the protein consumption of the nation (Murshid and Yunus 2017). The per capita consumption of rice in Bangladesh is the largest among the countries of Asia. The country meets it rice demand mainly through its own production. Rice cultivation accounts for 48% of total rural employment[2]. 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 (Ivanic *et al*. 2012). The large increase in rice price in 2007-2008 reduces household welfare and raises the headcount poverty of Bangladesh (Hasan 2017). Since June 2016, rice price in Bangladesh has started to increase sharply and remained high until this April 2018 and it increases by about 30-50% (see figure 1). Such rice price shock is an important policy concern to policymakers and non-profit organizations because this shock may again hurt welfare of the low-income households and increase poverty rate. This is likely to pose a serious challenge in achieving goal 1 of Sustainable Development Goals (SDGs)[3].

Literature that analyzed the impact of rice price shock on Bangladeshi household welfare is scarce and used data prior to 2011. Ivanic *et al*. (2012) estimate the potential first-order approximation of welfare loss mainly following the method used by Ivan and Martin (2008) and originally proposed by Deaton (1989, 2000). Hasan (2017) includes a second order approximation in his welfare measure which allows households to respond their consumption and production behaviors to changes in prices. A first-order measure is an appropriate tool for infinitesimal changes or smaller variations in prices whereas second-order effect is recommended for large price variations (Tiberti and Tiberti 2018). Given the magnitude of price changes both in 2007-2008 and 2016-2018 in Bangladesh, it is more appropriate to include second-order approximation in analyzing the impact of price changes on household welfare.

We use the first- and second-order approximation of welfare measure and contribute to the growing literature on the impact of food price shocks household welfare and poverty in rural Bangladesh by accounting for the heterogeneous increase in price. We also provide a disaggregate analysis of the effects on poverty in terms of household market participation, income quintile, land ownership, and regions. Allowing for heterogeneous price increase across each household and a differential price increase for net buyers and net-sellers in the analysis of household welfare and rice (food) price shocks are the main contributions of this paper. Relying on the assumption of same price and price changes may lead to biased estimation of the welfare and poverty effects caused by food price shocks when analyzing effects on different geographical and socio-economic groups (Levin and Vimefall 2015).

The impacts of the increase in rice price on household welfare and poverty mainly depend on the net position of the households as a 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 net buyers,

[1] Population statistics is from UN estimates (July 2018)
[2] http://www.knowledgebank-brri.org/riceinban.php
[3] The core SDG indicator of the SDG goal 1 is to end poverty in all forms and dimensions by 2030 from everywhere.

then the net impact of rice price will lower the number of poor households or vice versa. Thus, the main objective of this paper is to investigate these issues in more details and provide a comprehensive analysis of changes in household welfare and poverty in rural Bangladesh to an increase in rice price. We conduct the analysis using 2015 Bangladesh Integrated Household Survey (BIHS) data conducted by the International Food Policy Research Institute (IFPRI), Bangladesh.

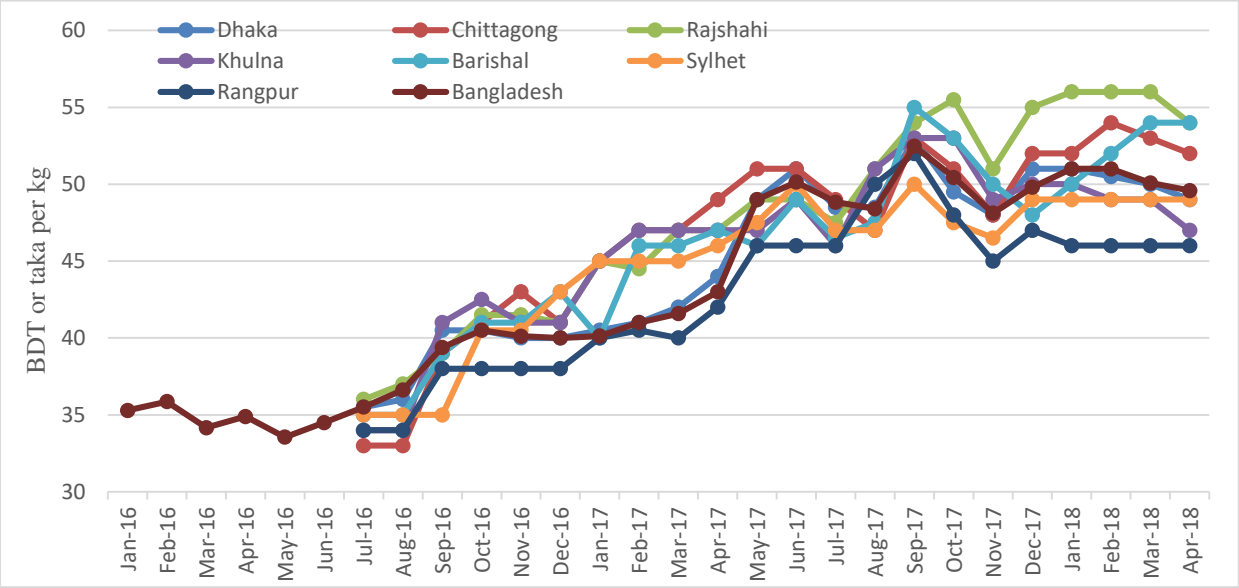

Figure 1: The trend of Rice Price in Bangladesh and different regions of Bangladesh[4]

Source: Food and Agricultural Organization (FAO) GIEWS FPMA Tool. http://www.fao.org/giews/food-prices/tool/public/#/home and Department of Agricultural Marketing (DAM), Government of the People of Republic Bangladesh.

2. Literature Review

A 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. Two studies below focus on Bangladesh.

Mghenyi *et al.* (2011) estimate the effects of a large increase 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. The authors show that a 25% arbitrary increase in maize price leads to the welfare effects ranging from -10% (loss) to 10% (gain) and the effects on poverty are not much stronger.

Levin and Vimefall (2015) extend the study of Mghenyi *et al.* (2011) analysis by accounting for the heterogeneous maize price increase. They assume consumers and producers face separate price changes and estimate the welfare effect of that changes. They use 2005-06 Kenya Integrated Household Budget Survey (KIHBS) and their results show that the welfare of

[4] We had the access to regional price data from July 2016.

net sellers and buyers' changes by 14% and -11%, respectively. The poverty rate increases by 1-3 percentage points (PP).

Minot and Dewina (2015) examine the effects of a 2007-08 maize price increase on welfare and poverty for Ghanaian households using a modified method of Deaton (1989) approach. They use the 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. They also find that in the short-run the poverty rate increases by 0.3 PP and in the long run the effect is almost null.

Badolo and Traoré (2015) examine the effects of global rice price hike on poverty and income inequality for Burkina Faso households. In order to calculate the effect of a rice price increase on real income, they use the concept of compensating variation(CV). 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). They also find that the poverty rate rises in the short-run but mitigates in the long run.

Balagtas *et al*. (2014) evaluate the impact of a 2007-2008 rice price increase on income and rural poverty in Bangladesh. Using longitudinal survey data available for years 1988, 2000, 2004, and 2008, they link household characteristics and market characteristics with poverty status and find that the sharp increase of 2007-2008 price raises the headcount poverty rate by 12 PP.

Hasan (2017) analyze the effects of a large rice price increase (50%) on household welfare and poverty in Bangladesh. His work is similar to methodology as Mghenyi *et al.* (2011) and Badaro and Traoré (2015) use. One improvement comes from using consumption in lieu of income as welfare indicator, given income may be subject to measurement error. By exploiting 2010 Bangladesh Household Income and Expenditure Survey (HIES), the author finds that the first-order welfare measure provides an overestimation (6% loss) of the welfare effects. On the contrary, the second-order measure shows a welfare gain of 2.8%. Using Foster (1984) poverty measure and a simulation method, the author finds that price shocks worsen the poverty situation across Bangladesh.

To summarize, studies on household welfare changes and food price shocks including Bangladeshi households mainly used first-order and second-order welfare approximation derived from an indirect utility function. Our paper also uses the same method but we extend the analysis by allowing for a heterogeneous price increase at the household levels and at the net-buyers and net-sellers level.

3. Methodology and data

3.1 Welfare effects of the 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 CV measure of the welfare effect can be expressed as (Mghenyi *et al*. 2011)

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

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. In this paper, we use household expenditure as the proxy of income.

Assuming households faces differential price and price changes, then with the modification of Mghenyi *et al.* (2011) we can write the second-order welfare effects of price changes for net-buyers and net-sellers as follows

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

$$m_i^{seller} \approx (s_i^s - s_i^d)\lambda_i - 0.5\left[s_i^s \xi_i^{ps} - s_i^d \xi_i^{pd} \right]\lambda_i^2 + 0.5\left\{ (R_i - \xi_i^{yd})\left[(s_i^d)^2 - 2 s_i^d s_i^s \right] + R_i (s_i^s)^2 \right\}\lambda_i^2 \quad (3)$$

where both equations (2) and (3) are second-order Taylor series approximation of (1) at $(p_i^0, m_i) = (p_i^1, 0)$ using Roy's identity and Hotelling's lemma to solve for m_i [see the deduction in Mghenyi *et al.* (2011)]. s_i^s and s_i^d denote the share of the monetary value of rice production and rice consumption in total expenditure; λ_i denotes $\frac{p_i^1 - p_i^0}{p_i^1}$ (the change in price as a proportion of the post-change price level); 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).

The term $(s_i^s - s_i^d)\lambda_i$ in the right-hand side of equations (2) and (3) is the first-order welfare effect of the price change. The remaining parts are the second-order welfare effect. The first-order welfare effect is the immediate or short-run impact of the price change in which net sellers gain and net buyers' loss from an increase in price. The second order effects allow the responsiveness of demand for and supply of rice to changes in rice price as well as income elasticity of demand.

3.2 Poverty effects of the rice price increase

We examine the poverty impact of rice price increase using a descriptive statistical method. 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 and lower poverty lines. The national upper poverty line and lower poverty line per capita monthly income (expenditure) are Tk 2268 or $30 USD and Tk 1862 or $24.62 USD, respectively. Third, we calculate monthly welfare losses (gains) and adjust the losses (gains) with the total monthly household income. Then we compare the headcount rate (HCR) of poverty before and after the price increase. Last but not least, we estimate what portion of the net sellers move out of poverty and what portion of the net buyers fall into poverty.

3.3 Data

This study utilizes 2015 Bangladesh Integrated Household Survey (BIHS) data. BIHS 2015 is a cross-sectional data and provides detailed information on household consumption, agriculture production, economic shocks and events, education, employment, and food security including many others. The sample is nationally representative of rural Bangladesh as well as a representative of rural areas of each of the seven administrative divisions of the country: Barisal,

Chittagong, Dhaka, Khulna, Rajshahi, Rangpur, and Sylhet. The total number of households in the survey is 4,619, which is nationally representative and can be inferred about the rural population. This study uses a total of 4415 rural households for the analysis[5].

4. Empirical Results

4.1 Who gains and who loses from the increase of rice price

As mentioned in section 1, net sellers would gain and net buyers would lose from the increase in rice price. Figure 2 shows the distribution of net sellers and the net buyers of rice. From the figure, we see that in rural Bangladesh only 26.07% of households are net sellers. This indicates that the net impact of the increase in rice price on household welfare would be negative since more than 70% of the rural households would be negatively affected due to loss of their purchasing power.

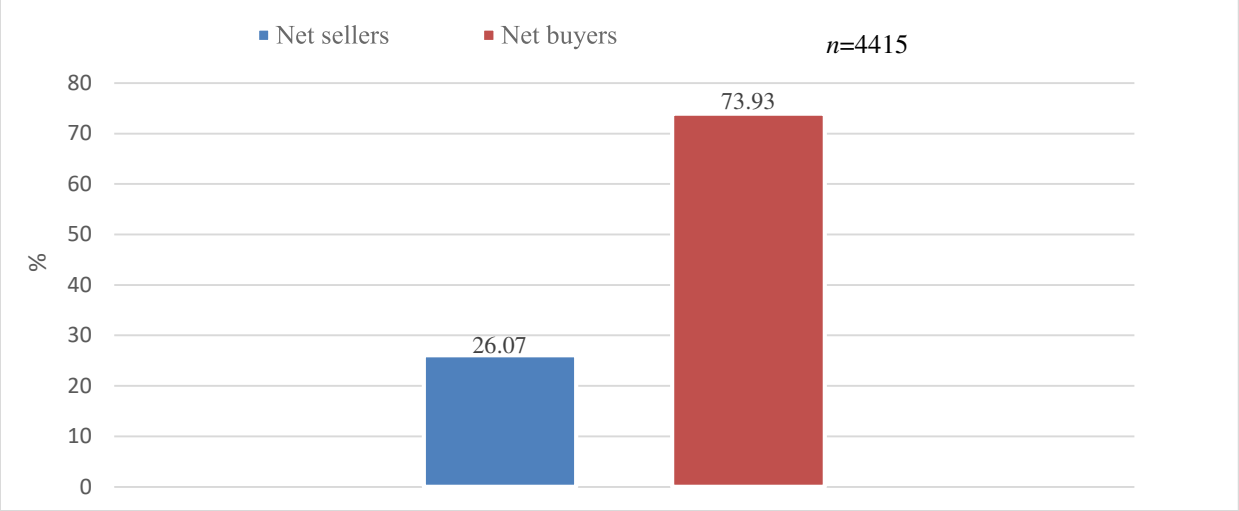

Figure 2. Distribution of rural households by net sellers and buyers

Now turning our analysis to the distribution of poor by net sellers and buyers, we find that about 18.9% of the total net sellers are poor households and about 28.2% of net buyers are poor. (Figure 3). This statistic indicates that a portion or all of the 18.9% 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 71.8% of the net buyers. If the number of people (seller households) moves out of poverty is greater than the number of people (buyer households) 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.

[5] We exclude 204 observations from our sample with unusual (negative or zero) consumption or production.

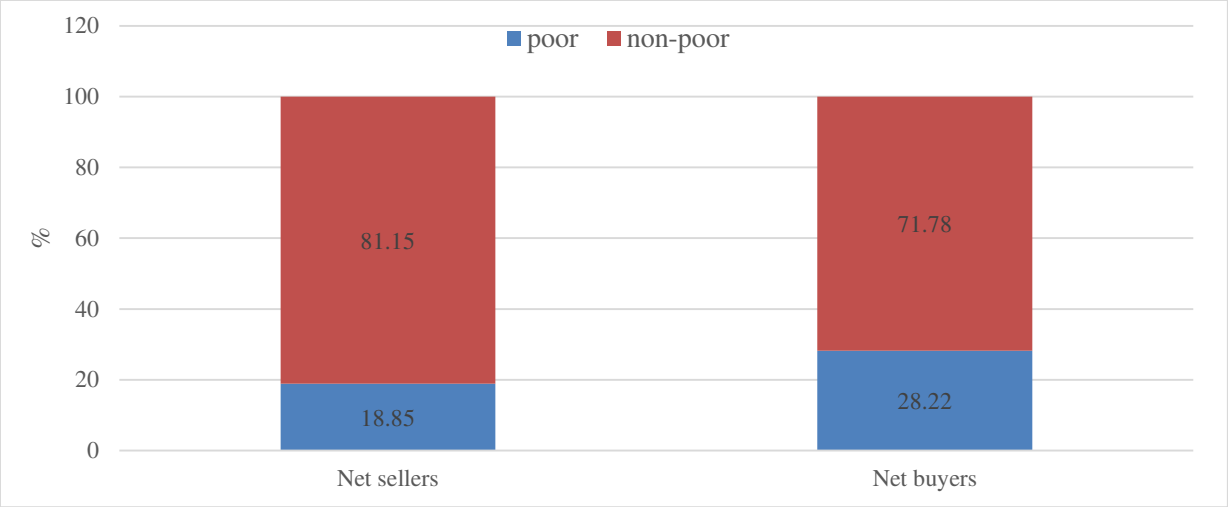

Figure 3. Distribution of poor (HCR) and non-poor by net sellers and net buyers before the increase in price

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

Next, we see the distribution of own land by rural households and by net sellers. It is expected that the majority of rural households who are landless or marginal farmers would be net buyers and the poverty is linked to land owned by a household. An additional hectare of land raises a household income by approximately 20% to 23% (Nargis and Mahbub 2006; Balagtas 2014) and therefore that household is likely to be above the poverty line income. In terms of the distribution of total own land, about 71.7% of the total households are either landless or marginal landowner (left panel in figure 4). Only about 10.4% rural household (medium and large farmers) has land more than 1.5 acres. Of the total households that do agriculture, about 87.1% are either landless or marginal farmers (right panel in figure 4). Of the rural households that are landless, only about 9.30% are net sellers of rice; of functionally landless households, only about 12.5% are net sellers of rice (figure 5). All these indicate that most rural household would hurt by the rice price increases.

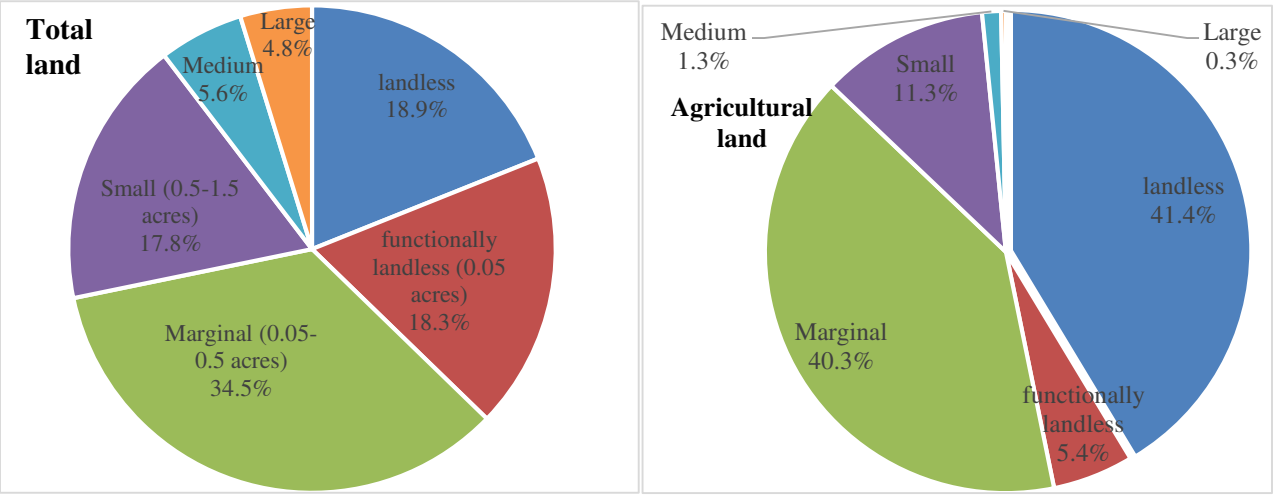

Figure 4. Population share (%) by total land and agricultural land ownership (Rural)

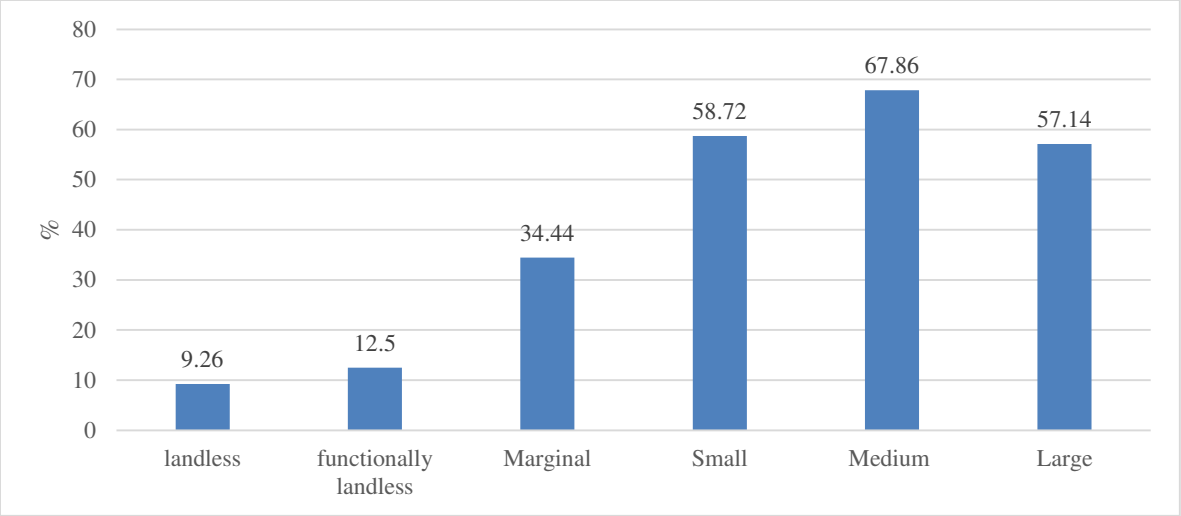

Figure 5. Net seller by agricultural land ownership (Rural)

Now, we see the rice and food consumption patterns of rural households by income or expenditure quintile to examine which household group would be hurt badly due to an increase in rice price. Table 1 shows that rice constitutes about 25.5-36.6% of food expenditure and 15.1-22.4% of total expenditure, respectively, for about half of the population in rural Bangladesh. And food constitutes about 60.7-62.1% of total expenditure. The statistics in table 1 also indicates that the share of rice expenditure increases as we move towards the poorest group. The poorest 20% of the population spends 36.6% of their food expenditure for rice as against 17% by the richest 20% of the population. This consumption pattern indicates that an increase in rice price would have a direct and negative impact on the purchasing power of the poorest group.

Table 1. Expenditure pattern by income or expenditure quintile

Expenditure quintile		Per Capita Expenditure (Tk/month)			Share (%)		
		Total	Food	Rice	Rice in food	Rice in total	Food in total
Lowest	1	1678.1	1045.3	370.4	36.6	22.4	62.1
	2	2388.4	1473.0	427.6	29.7	18.0	61.7
	3	3051.3	1849.2	457.2	25.5	15.1	60.7
	4	4016.7	2336.5	482.1	21.3	12.1	58.2
Highest	5	7071.1	3680.4	577.7	17.0	8.7	53.1

4.2 Welfare Impact

We use equations (2) and (3) to estimate the welfare effect of a large increase in rice price. We allow a 35% increase in retail price for net buyers based on the data as shown in figure 1 in section 1[6]. For the net-sellers, we allow a 28.5% increase in price. This increase is from the survey year

[6] The regional trends of rice price are similar. We find that the correlation coefficients between regional and national prices are close to one. It varies from 0.894 (Sylhet) to 0.995 (Dhaka). Thus we allow similar percentages changes across all regions.

2015 to 2016-2018. We assume that 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 a 1.22% retail price increase) to calculate the net-sellers or wholesale price change (Alam *et al.* 2016). We use survey data to compute s_i^s and s_i^d. In case supply and demand elasticity of rice price, we use 0.248 (Murshid and Yunus 2017) and 0.45 (Hasan 2017). The income elasticity is assumed to be 0.60 (Hasan 2017). The value of R is assumed to be 1.0 (Hasan 2017; World Bank 2010)[7]. Our estimate of the welfare effects shows what would have changed had the rice price shock taken place when the survey was conducted.

Table 2 presents the mean and standard deviation (SD) of the welfare effects of rice price changes across seven regions or divisions and for the whole country. The first-order effects provide more negative values than the second-order effects. This indicates that allowing demand and supply response to price minimize the welfare loss. The results of the first-order effect indicate that expect for Rajshahi division, the welfare decreases in all divisions. In the second-order effects, the effects for Rangpur division turn out to positive. The effects for Rajshahi and Rangpur are positive because these two divisions have higher proportions of net sellers of rice compared to other divisions. Overall, the results suggest that the impact of the rice price increase on household welfare is negative and a better result can be obtained by using a second-order approximation which allows supply and demand response to the price increase.

Table 2. Impact of a large rice price increase on household welfare (weighted)[8]

Region	First-order approximation		Second-order approximation	
	Mean	SD	Mean	SD
Barisal	-0.015	0.067	-0.011	0.071
Chittagong	-0.023	0.028	-0.021	0.028
Dhaka	-0.009	0.087	-0.003	0.105
Khulna	-0.013	0.054	-0.010	0.057
Rajshahi	0.013	0.133	0.024	0.168
Rangpur	-0.003	0.093	0.002	0.106
Sylhet	-0.017	0.059	-0.014	0.065
Bangladesh	-0.010	0.083	-0.005	0.100

Note: These estimates are based on equations (2) and (3) and assuming 35% price increase for net-buyers and 28.5% price increase for net-sellers, as well as assuming ξ_i^{ps}=0.248, ξ_i^{pd}=0.45, ξ_i^{yd}=0.60, R =1.

[7]Schluter and Mount (1976) conduct experiments in rural India (a developing country) and obtain coefficient of relative risk aversion estimates ranging from 0.05 to 3. Thus we do the robustness check assuming the value of *R* (relative risk aversion) equals 3, 1.5, 0.9, 0.8, 0.5, and 0.05. The welfare effect is not sensitive to these range of values. Mghenyi *et al.* (2011) also find similar results for Kenya. Results are not reported in the paper and are available on request.

[8] The sampling weights have been used to represent nationwide impacts of the rice price increase.

4.3 Poverty Impact

The impact of rice price changes on poverty is difficult to estimate because the poverty rate is affected by many other factors other than the increase in price. Thus, we attempt to estimate the additional number of households or individuals fall below the poverty line because of the large increase in rice price. This measure is the short-run impact of the price shock, i.e., what would happen to poverty rates if the household surveyed in 2015 face a new large price and no other change in other factors occur. We allow the same 28.5% increase in price for net sellers and a 35% increase in price for net buyers as used in analyzing the welfare effects. Though the percentage change in price is the same for all net buyers and net sellers, the magnitudes of price changes vary across each household because the prices vary across each household. While calculating the poverty impact, this paper compares pre and post price shock income using both national and regional upper and lower poverty lines income.

The estimations of the 2016-2018 rice price increase on poverty indicate that the effects are quite large (Table 3). The HCR of poverty (estimated using the upper poverty line) in rural Bangladesh increases by 1.72 percentage point from 25.78% in 2015 to 27.5%. The results also show that the HCR of poverty estimated using the lower poverty line increases by 1.43 percentage point. This result implies that far number of buyers fall into poverty than the sellers who move out of poverty. The estimation results using the upper poverty line show that about 3.90% net sellers move out of poverty as against 3.70% increase in HCR of poverty among buyers. Since net sellers constitute only 26.07% of rural households, the overall HCR of poverty (estimated using the upper poverty line) in rural Bangladesh increases by 1.72 percentage points. The results in table 3 also show about 1.91% net sellers move out of poverty (estimated using the lower poverty line) as against 2.60% increase in HCR of poverty among buyers. Taking into account this increase in HCR of poverty, we calculate the number of people falls below the poverty line for rural Bangladesh. Our estimates suggest that about 1.82 million additional people fall below the upper poverty line and 1.51 million additional people fall below the lower poverty line because of a 35% increase in retail rice price and a 28.5% increase in wholesale price.

Table 3. Impact of a large rice price increase on HCR of poverty (percent, weighted)

Household Group	Upper poverty line		Lower poverty line	
	No change in price	after price increase	No change in price	after price increase
Net seller	18.85	14.94	6.86	4.95
Net Buyer	28.22	31.92	15.72	18.32
Bangladesh	25.78	27.5	13.41	14.84

The impacts of rice price shock on regional poverty have been shown in table 4. The results in terms of upper poverty line show that except for the Khulna division, all other divisions hit hurt badly because of an increase in rice price. The estimates of HCR of poverty in terms of the lower poverty line show that the poverty rate increases in all divisions. When the impacts are calculated using the upper poverty line, the largest effect is evident in the Chittagong division followed by Rajshahi, Dhaka, and Rangpur divisions. When the impacts are calculated using the upper poverty line, the largest effect is evident in the Barishal division followed by Rangpur, Khulna, and

Chittagong divisions. The reason for this increase in HCR of poverty in each region is similar to that of our national findings, i.e., in these divisions or regions the number of buyer falls below the poverty line is higher than the number of sellers moves out of poverty (Figure 6). And the results also indicate that the distribution of net sellers across all regions are similar to that of national distribution, i.e., there are far more net buyers in each region than the net sellers.

Table 4. Impact of a large rice price increase on HCR of poverty in different regions (percent, weighted)

	Upper poverty line			Lower poverty line		
Division	No change in price	after price increase	Difference	No change in price	after price increase	Difference
Barisal	30.38	31.65	1.27	20.25	24.05	3.8
Chittagong	20.23	22.46	2.23	10.06	11.86	1.8
Dhaka	20.19	21.66	1.47	11.98	13.09	1.11
Khulna	13.86	13.86	0	5.94	7.92	1.98
Rajshahi	23.73	25.42	1.69	13.56	14.92	1.36
Rangpur	36.33	37.8	1.47	19.27	22.2	2.93
Sylhet	10.28	11.67	1.39	8.75	9.86	1.11

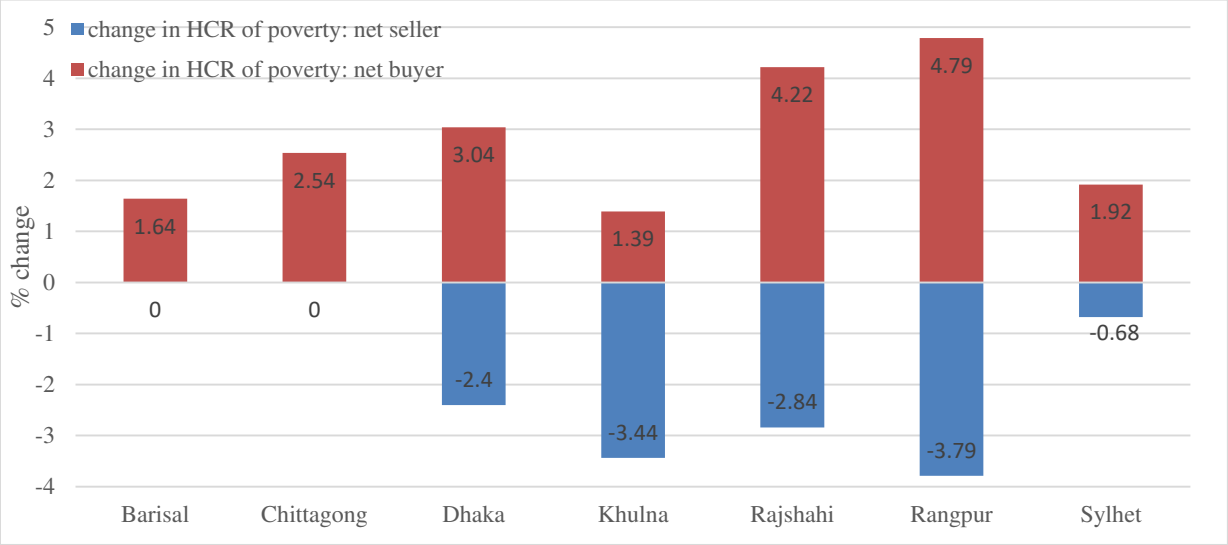

Figure 6. Poverty impact by region and by net sellers and buyers estimated using the upper poverty line

Now, we turn our discussion to the changes in the dynamics of poverty caused by the increase in rice price[9]. The dynamics poverty has been categorized into four groups based on the poverty status of before and after price increases. They are a) non-poor remain non-poor b) poor stay poor, c) poor move out of poverty, and d) non-poor fall into poverty. The analysis of the dynamics of poverty shows that the percentage of non-poor fall below the poverty line is higher

[9] We discuss the dynamics of poverty and rest of the section using the upper poverty line.

than the percentage of move out of poverty by 1.72 percentage point (figure 7), which reconfirms our findings on the changes in HCR of poverty as shown in the second paragraph of this section.

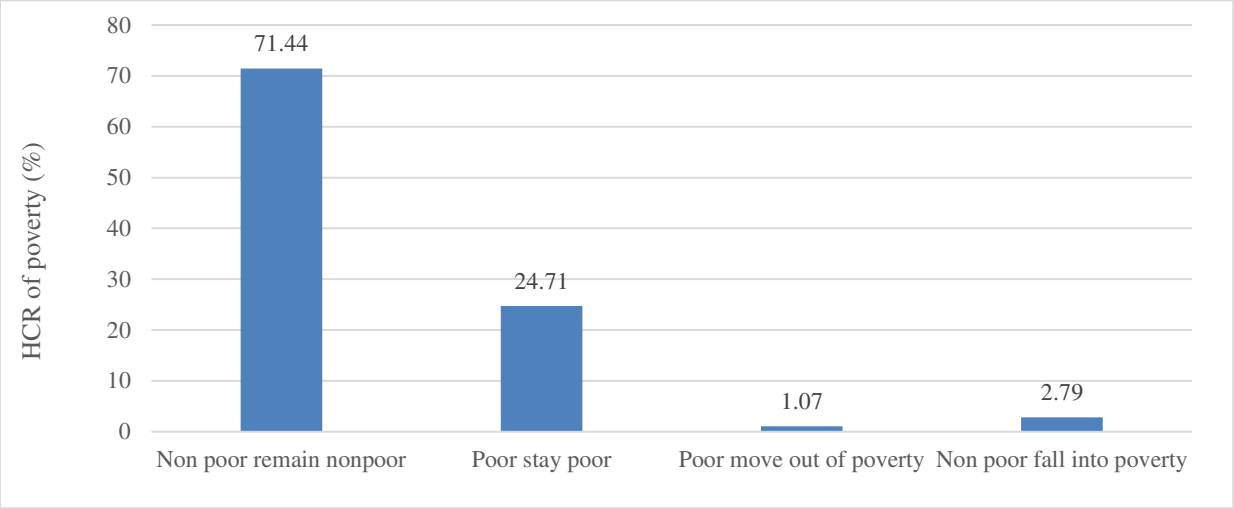

Figure 7. Dynamics of Poverty caused by a large rice price increase

As mentioned earlier, the poorest 20% of the population who spend a large share of their income and are net buyers are likely to be affected badly by the price shock. The findings of figure 8 confirm this hypothesis. The figure shows that the number of people who falls below the poverty line is from the 2nd quintile group. The number of people who move out of poverty is also mainly from the 2nd quintile. They move above the poverty line as they are net sellers and their income increase because of the increase in price.

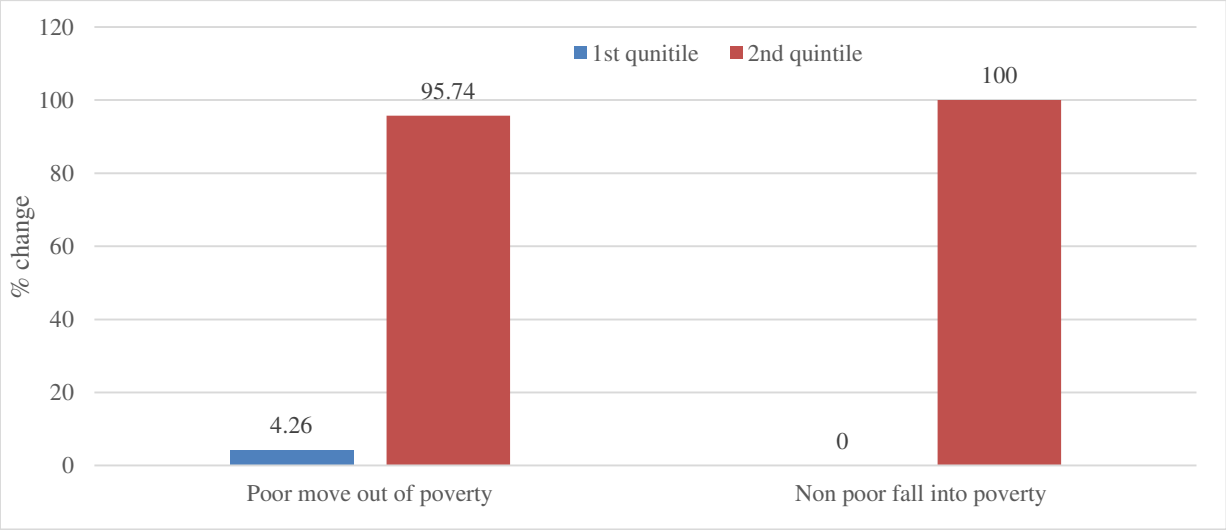

Figure 8. Dynamics of poverty by expenditure quintile

Now turning our analysis to the dynamics of poverty by agricultural land ownership, we find that majority non-poor household who fall into poverty are from landless and functionally landless farmers while the majority poor households who move out of poverty are marginal farmers (figure 9). Marginal and small farmers move out of poverty more in numbers than the landless and functionally landless farmers. These results indicate that owning more agricultural land increases the chance that a household would move out of poverty. We investigate this hypothesis by estimating a probit regression. The probit regression regresses poverty on total agricultural land owned by a household. The probit model for this specification can be written as

$$P_i\left[Y_i = 1 | X_1, X_2, ..., X_n, \beta_0, \beta_1\right] = \Phi(\beta_0 + \beta_1 X_i) \quad (4)$$

and the marginal effect of X for X_i is

$$\frac{\partial P_i}{\partial X_i} = \beta_1 \phi(\beta_0 + \beta_1 X_i) \quad (5)$$

where Y_i denotes poverty status ($Y_i = 1$ if a household is non-poor and $Y_i = 0$ if a household is poor) for household i and X_i refers to the total agricultural land owned by a household i. The coefficient in equation (4) shows z-score and it can be interpreted as a one-unit increase in X_i corresponds to an increase in the z-score for the probability of being non-poor. The marginal effect (equation 5) can be interpreted as one unit increases in X_i raises the probability of being non-poor by some percentage. The marginal effect is practically more appealing and intuitive because it shows the change in probability. Thus we below interpret the marginal effect.

Results of the regression are shown in table 5. The table reports the estimates of both coefficient and marginal effect. The result (column 1b) shows that if agricultural land owned by a household goes up by an infinitesimal amount, then the probability that the household will be non-poor increases by 15.5 percentage points (calculated at the sample mean). The mean predicted probability of being non-poor is 0.753 (75.3%) if agricultural own land is 0.220 acres (sample mean).

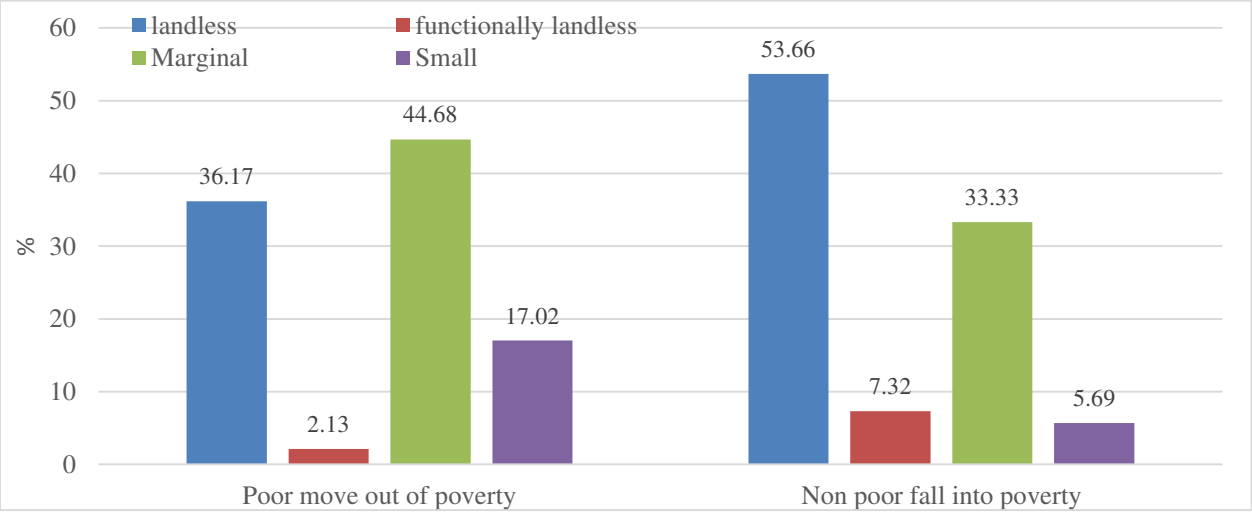

Figure 9. Dynamics of poverty by agricultural land ownership

Table 5. The effects of agricultural land holding on households' poverty: A Probit estimates

Explanatory variable	Poverty status using upper poverty line (0=poor, 1=non-poor)	
	(1a)	(1b)
	Coefficient	Marginal effect
Agricultural own land (acres)	0.491***	0.155***
	(0.066)	(0.021)
Constant	0.658	
	(0.055)	

Note: *** denotes significant at 1% level of significance. Standard errors in the parentheses.

5. Conclusions

Utilizing the 2015 BIHS data and accounting or heterogeneous increase in price at the household level, 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 the poverty rate in rural Bangladesh. A 35% increase in retail price and a 28.5% increase in wholesale rice prices lead to a 1.72 and 1.43 percentage points increase in the HCR of poverty obtained using the upper and lower poverty lines, respectively.

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 moves out of poverty. The results estimated using the upper poverty line show that about 4% net sellers move out of poverty as against 3.7% 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 by 1.72 percentage point. When we calculate this decomposition using the lower poverty line, we obtain that about 1.91% net sellers move out of poverty as against 2.60% increase in HCR of poverty among buyers. Taking into account this increase in HCR of poverty, we calculate the number of people fall into poverty for rural Bangladesh. Our estimates suggest that about 1.82 and 1.51 million additional people fall below the upper and lower poverty lines, respectively. On the regional variation of the impact, this paper finds that the increase in rice price reduces the welfare of the households in all the regions except for Rajshahi and Rangpur and raises the HCR of poverty in all the regions except for Khulna region when estimated using the upper poverty line and in all regions when estimated using the lower poverty line. Our analysis also shows that the poorest 20% of the population hit hurt badly because of the price shock and an additional acre of agricultural own land increases the chance of being non-poor by 15.5 percentage points.

Our analysis of the price shock on household welfare and poverty has limitations. Our estimates of the impact of price shock on household welfare consider the second-order approximation of CV measures which allows supply and demand response to price. However, we assume a constant supply, demand, and income elasticities across all regions and income groups. Our estimates of the poverty impact only show the short-run impact of price increase since the analysis does not take into account substitution effects across food categories, supply response to price, and wage responses to price. Taking into account this factors perhaps would minimize the negative impact on poverty. Thus, one should consider our analysis carefully. Future research should address these issues while calculating the poverty impact of a large price increase.

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