WFL Publisher
Science and Technology
Meri-Rastilantie 3 B, FI-00980
Helsinki, Finland
e-mail: info@world-food.net

Journal of Food, Agriculture & Environment Vol.13 (2): 107-117. 2015 *www.world-food.net*

Rice price inflation and its impact on poverty and livelihood: Insights from Bangladesh

Taznoore S. Khanam *, Humnath Bhandari and Samarendu Mohanty
Social Sciences Division (SSD), International Rice Research Institutes (IRRI), College, Los Banos, 4031 Laguna, Philippines.
**e-mail: t.khanam@irri.org, h.bhandari@irri.org*

Received 2 January 2015, accepted 18 March 2015.

Abstract

Rice is the major staple food in Bangladesh, contributing 71% of total calorie supply, 58% of total protein intake, and 15% of rural household income. More than half of Bangladeshi households are net buyers of rice. Poor households spend 40% of their food expenditure on rice. By reducing real income and purchasing power, a rice price inflation worsens food insecurity and, in turn, poverty for millions of Bangladeshi households. Rapid rice price inflation in recent years is thus a serious concern. The Green Revolution led continuous growth in rice yield kept rice prices low. Low rice prices reduced poverty through better food security, higher real income, and improved livelihoods. Rice prices have, however, spiked significantly in 2008 and again in 2010 and 2013. This study investigates the causes of rice price inflation and its effects on rural livelihood and examines poor households' coping mechanisms to higher rice price. We found that the 2008 food price hike pushed an additional 9 million Bangladeshis below the poverty line. Higher rice price increased poverty incidence and overall inflation in Bangladesh. Several elements on the demand and supply side and some other factors contributed to the rapid rise in rice prices in Bangladesh. Poor households adopted multiple food-based and non-food-based consumption-smoothing and income-smoothing strategies to cope with the impacts of higher rice prices. The consequences of some of these coping strategies are long term and irreversible. We conclude that rice price will remain high and will continue to rise in the future with adverse impact on food security and poverty reduction efforts. We discuss several technological and policy solutions to further cap the sharp hike in rice price, to supply rice at an affordable price to the poor, and to minimize the impact of future rice price hike on millions of poor Bangladeshi households.

Key words: Rice price inflation, poverty, food security, coping strategies, Bangladesh

Introduction

Rice is the staple food in the Bangladeshi diet, contributing 71% of total calorie and 58% of total protein intake. It accounts for 31% of total food expenditure, and this share reaches as high as 40% for the poor [1]. Rice price hikes, therefore, can have a large impact on food security and poverty, especially of households living at or near subsistence levels. The effects, however, vary across households (depending on whether they are net consumers or net producers) and across countries (depending on whether they are net exporters or net importers). At the micro-level, more than half of Bangladeshi rural households are net buyers of rice. At the macro-level, Bangladesh is a net importer of rice. Indeed, a rice price hike poses a serious threat to the national economy, to food security, and to the country's poverty reduction efforts. By reducing real income and purchasing power, higher rice prices can aggravate poverty, hunger, and malnutrition because households not only reduce the quantity and quality of food consumed, they also sell their productive assets to meet higher consumption expenditure needs. The impact falls heaviest on the poor and the vulnerable, particularly on the rural smallholders and landless farmers, the urban poor, and the female-headed households. Empirical studies show that rice price hikes have increased the number of the poor in developing countries of Asia, but that magnitude differs across countries [2-4].

After staying at historic lows for decades, global rice prices have followed an upward trend beginning in the early 2000s, reaching a peak in May 2008 [2]. Prices fell in 2009 and 2010; they again spiked and remained high in 2011 and 2012 [5].These episodes of rice price hikes over the past few years have reduced the purchasing power of net rice consumers in many developing countries and have raised concerns. Since Bangladesh is well-integrated into the global market, global rice price hikes have affected the local economy. As a result, domestic rice prices in Bangladesh have increased substantially in the last few years [6]. The nominal price of rice increased at more than140% between 2000 and 2013 in Bangladesh. This may have aggravated the problems of food insecurity, malnutrition, and reduction of productive assets with adverse long-term implications, particularly among the poor and vulnerable groups. Such price hikes may not only bring more misery to the poor but also push millions of people living at the threshold income level into the poverty trap. Given the rising input costs and dwindling production resources, we expect rice prices to remain high in the future. Therefore, it is important to examine the effects of rice price hikes on poverty and how poor households cope with higher food expenditure. Literature on the micro-level impact of rice price hikes on poverty and households' coping mechanisms is scant. Most of these are based on aggregate-level secondary data, which focus on aggregate food prices. This study aims to bridge that knowledge

gap. A thorough understanding of what causes upward pressure in rice prices, what its impact is on poverty and livelihood, and how different income group scope with increasing rice prices will help in making appropriate policies and programs that address such events and target those most in need. The findings of this study will enable the Bangladeshi government, donors, and development workers to come up with short- and long-term measures that minimize the impact of price increase, help cap the upward pressure on rice prices, and develop safety-net programs for the poor.

Materials and Methods

We analyzed both primary and secondary data for this article. The primary data were the long-run panel data collected from sample rural households in Bangladesh in five waves (1988, 2000, 2004, 2008, and 2010)[7]. The first four waves of data were collected by International Rice Research Institute (IRRI) in the past. We collected the 2010 data by surveying the original sample households plus additional households. The data were drawn from a repeat survey of farm households located in 12 villages across 11 districts in Bangladesh. The sample size covered a wide geographical area and diverse agro-ecological environments. A stratified random sampling method was used to select the sample villages. The households in the sample villages were classified into income groups and households were selected randomly from each income group using proportional sampling. In 1988, total sample size was 24 households comprising 20 households in each of the 12 villages. Sample size increased over the years. In 2000, 2004, and 2010, the total sample size was 360 households each year comprising 30 households in each of the 12 villages. The sample covered original households living in the village, their offshoots, and randomly selected additional households. In 2010, the total sample size increased to 480 households comprising 40 households in each of the 12 villages. Again, the sample covered original households living in the village, their offshoots, and randomly selected additional households. (We refer readers to Hossain and Bayes [8] for details of the sampling design of the previous waves of surveys.) We analyzed all five waves of data to estimate poverty rate over time. Then we used a simple descriptive approach to correlate poverty trends with rice price trends to examine the impact of rice price hikes on poverty and livelihoods.

We analyzed the household panel data using the Foster-Greer-Thorbecke poverty index [9] to estimate the incidence and depth of poverty in Bangladesh over time. The deficiency of income to meet basic needs is the most commonly used definition of poverty. Income poverty is determined by comparing household income to an estimated national poverty line using a normative food basket and a market price attached to each unit of food item. In this study, the poverty line is defined as the level of expenditure needed to provide a balanced diet with a minimum of 2,100 calories, with a 30% (of poverty-level income) allowance for basic non-food items per day for each household member [8]. The estimated national poverty lines were Taka 4,610 in 1988; Taka 7,020 in 2000; Taka 8,330 in 2004; Taka 15,190 in 2008; and Taka 16,710 in 2010. The Foster-Greer-Thorbecke poverty index is defined by the following formula:

$$P_\alpha = \frac{1}{n}\sum_{Y_i < z}^{q}\left[\frac{(Z - Y_i)}{Z}\right]^\alpha$$

where Y_i is the real per capita income of a household *i*, *n* is the total household population, *z* is the poverty line, and α is a measure of aversion to inequality. The above equation yields three measures of poverty for three different values of α.

i. When $\alpha = 0$, P_α is the share of poor people in the population, a measure of the incidence of poverty.

ii. When $\alpha = 1$, P_α is the weighted average of the distance below the poverty line, a measure of the depth of poverty.

iii. When $\alpha = 2$, P_α is the poverty gap ratio squared. The distance below the poverty line is squared, such that P_α is an alternative measure of poverty depth, giving greater weight to those households deeper in poverty.

In addition to the primary data, we analyzed four different sources of secondary data in this article. These secondary data were from the Household Income and Expenditure Survey (HIES) in 2010, the Agricultural Census in 2008, the long-run time-series agricultural commodity prices since 1970, and household data collected by other studies related to poor households' coping mechanisms to higher food prices [1, 10]. We analyzed the HIES data to examine household consumption and expenditure patterns, the agricultural census data to develop a matrix of farm size and rice self-sufficiency status, and the agricultural commodity price data to examine rice price hikes. We analyzed household data collected by two empirical studies in Bangladesh to examine poor households' coping mechanisms to higher rice prices.

Results and Discussion

Households' food consumption pattern: Availability and access to staple food grains, major elements of food security, have improved substantially over the past 4 decades in Bangladesh. The average per capita cereal grain production increased at 26% from 270 kg in 1970 to 340 kg in 2010. In spite of this large improvement in domestic food grain production, Bangladesh has not yet become self-sufficient in cereal grains. The deficits in domestic rice and wheat production are met through commercial imports [6]. From 2009 to 2011, Bangladesh, on average, imported 0.7 million ton (t) of milled rice and 2.9 million t of wheat annually[11]. Being a net importer of food grains, the higher food prices will negatively affect the Bangladesh economy.

Rice is the predominant source of energy in the Bangladeshi diet (Fig.1). The average annual per capita milled equivalent rice consumption in Bangladesh (152 kg) is one of highest in the world[10]. Annual per capita rice consumption is significantly higher in rural areas (161 kg) than in urban areas (126 kg). Recently, Bangladesh has observed a decline in per capita rice consumption, albeit insignificantly. Between 2005 and 2010, annual per capita rice consumption decreased by 1.2%. Reduction was higher in urban areas (2.0%) than in rural areas (0.8%). Three factors explain these observations: the first is consumption pattern and lifestyle. Members of rural households do more physical work than their counterparts in urban households. Hence, rural households require more energy and the former consume more rice than the latter. The second factor has something to do with the effect of income on rice consumption. As income rises, people start diversifying their diets away from rice [12]. The burgeoning middle- and high-income class households, particularly in urban areas, reduce rice consumption in favor of a more diversified diet. The third is the effect of rice price hike on rice consumption. Urban households solely depend on the market for their rice requirements. Among

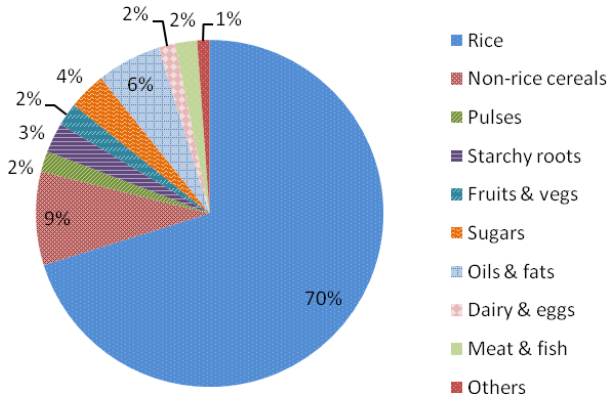

Figure 1. Percentage dietary composition of per capita calorie supply, Bangladesh, 2007–2009 [11].

rural households, medium and large farmers meet their rice requirements from their own production, but small and landless farmers buy some of their rice requirements from the market. Therefore, the effects of rice price hikes are felt more among poor households in rural and urban areas. These poor households reduce the amount of rice they consume to cope with higher rice prices. As millions of households are net buyers of rice, price hikes have clear adverse effects on income, food security, and malnutrition, such that households decrease the quantity and quality of rice they consume.

Rice price trends and instability: The nominal price of rice in Bangladesh increased slowly from 1971 to 2006, but it has increased sharply since 2007, reaching a peak in 2008, 2011, and 2013 (Fig. 2). When compared with 2000, the annual nominal price of coarse rice was 142% higher in 2008, 149% higher in 2011, and 140% higher in 2013. The significantly higher rice prices in recent years led to a significant increase in food expenditure and negatively affected the livelihood of the poor. The Green Revolution that began in the mid-1960s increased rice yield two to three times[13]. The yield growth led to a significant increase in rice production in the 1970s and the 1980s, lowered rice prices, and supplied cheap rice to consumers. This scenario lasted up until the mid-2000s. Recent episodes of sharp rises in rice prices indicate that the era of cheap rice is now over. The high overall inflation in the economy and rapidly rising input costs are expected to push rice prices further upward in the future.

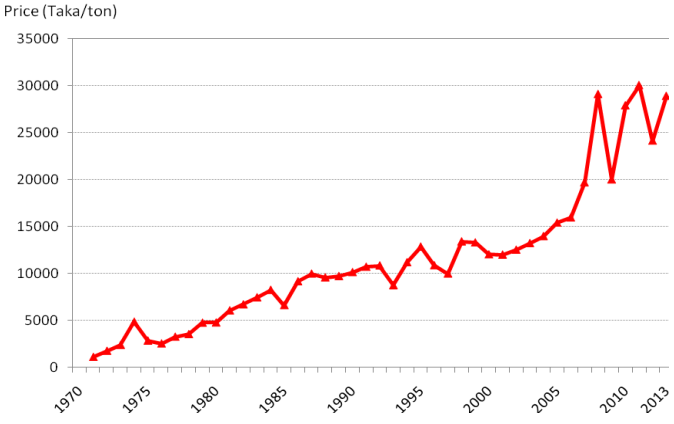

Figure 2. Annual nominal prices of milled coarse rice in Bangladesh, 1971-2013 [14].

Rice prices have been highly volatile in Bangladesh. The coefficient of variation—a measure of instability—of real price of rice was 19% in the 1970s, 15% in the 1980s, 13% in the 1990s, 1% in the early2000s, and 17% during 2006-2013. This shows that rice price volatility has increased significantly in recent years, when compared with those in the 1990s and the early 2000s.Volatile prices affect rural households in their consumption expenditure, production decisions, and income. These prices become problematic when they are high and unpredictable. This can create a level of uncertainty, which increases risks for producers, traders, consumers, and governments, leading to suboptimal decisions. Poor consumers are forced to reduce the quantity and quality of food in times of sudden price hikes.

Transmission of international rice prices into domestic markets: Between 2000 and 2008, domestic rice price trends echoed international rice price trends, indicating some degree of transmission of world rice prices into the domestic market, although the magnitude of the price increase in the domestic market was much smaller. However, between 2009 and 2013, domestic rice prices behaved differently from international rice price trends (Fig. 3). The international nominal rice prices—measured by the Thai export price of 5% broken rice—increased from US$240 per ton in January 2000 to $315 per ton in July 2006, and then to an all-time high of $930 per ton in May 2008. This price increased 3.9 times between 2000 and 2008. In Bangladesh's domestic market, the nominal price of coarse rice (average quality) remained fairly constant at $230 per ton from January 2000 to July 2006,and then increased to an all-time high of $470 per ton in July 2008. It should be noted that the exchange rate of Bangladesh taka to US$ depreciated by 32% between 2000 and 2006. This depreciation of local currency has partially caused a stable domestic price of rice in US$ terms. Using the fixed exchange rate of 2000, the nominal price of coarse rice in the domestic market increased 2.7 times from $230 in January 2000 to $620 in July 2008.

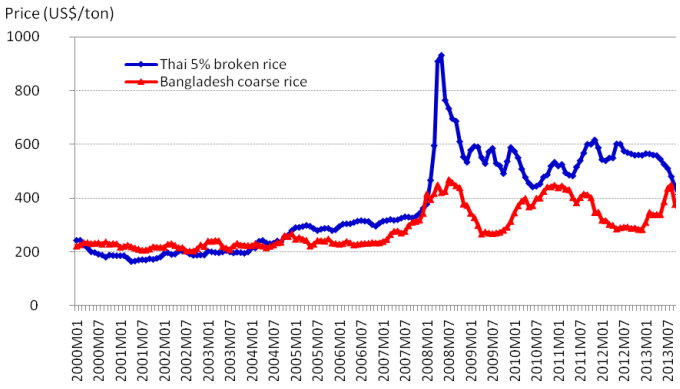

Figure 3. Monthly nominal price of milled rice in the domestic and international markets, 2000-2013 [14, 15].

Different trends in domestic rice prices, rather than the international rice price after 2009, indicate that domestic factors have been the major drivers of the price of rice in Bangladesh in recent years. The domestic rice price was the highest of the decade in 2008, but prices started to fall in July 2008 mainly due to the bumper harvest of boro rice in April-May 2008. Although prices fell throughout 2009, they started to rise at the end of 2009 and reached the highest price at $450 in December 2010. The bumper

harvest of aman (wet) rice in November-December 2010, as well as the bumper harvest of aman and boro rice in 2011 and 2012, caused rice prices to decrease, but again, rice prices showed an upward trend in 2013. We observed that rice prices have been highly unstable in recent years. Climate factors that affect the domestic rice production situation have been the main determinant of rice prices in Bangladesh. Yet, rice prices in the international market also put strong pressure on domestic rice prices.

Rice price hike and inflation: The general annual consumer price index (CPI) grew steadily from the beginning of 2000 and reached the peak in 2007 and again in 2011 (Fig. 4). It is evident from the figure that general inflation largely echoes food price inflation. Food inflation has increased steadily since 2000 and reached its highest in 2007 and again in 2010 and 2011. Between 2002 and 2010, food price inflation was significantly higher than that of non-food. In 2012, food items accounted for 55% of the overall inflation in Bangladesh (Fig. 5). Since food carries a large weight of the CPI in Bangladesh, food price inflation has caused a significant inflationary pressure in the country. Therefore, the significant rise in CPI in 2007 and 2011 can be attributed to the spike in food inflation. The contribution of rice price inflation to overall inflation was 20% in 2012. Since rice is the major item in the food basket, the rapid surge in rice prices contributed to substantial inflationary pressure on food and the economy. This indicates that changes in rice prices significantly influence food price inflation, which, in turn, affects the overall inflation of the economy. Thus, we can conclude that rice price hikes are important drivers of the economy's overall price inflation. Therefore, keeping rice prices low is an important policy instrument to minimize general price inflation.

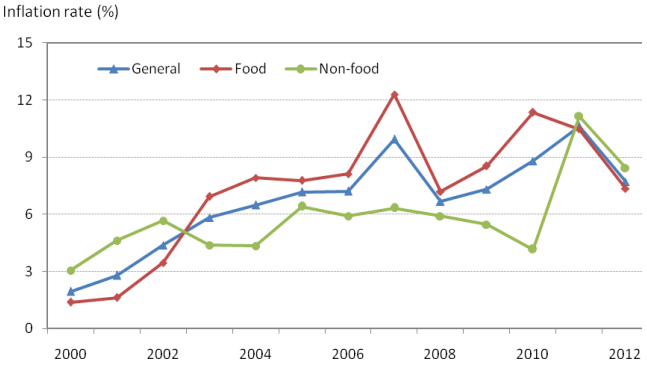

Figure 4. Food and non-food price inflation in Bangladesh, 2000-2012 [15].

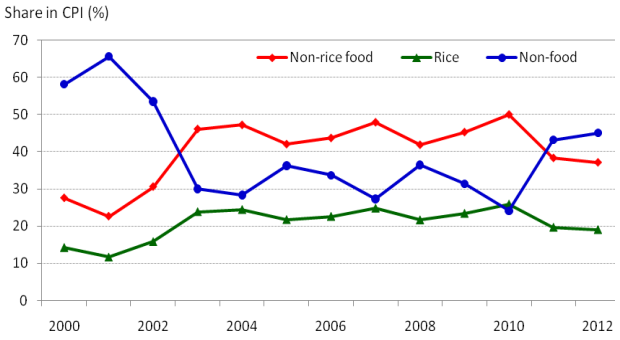

Figure 5. Contribution of food and non-food items to general consumer price index inflation in Bangladesh, 2000-2012 [15].

Effects of rice price hikes on different household groups: The effects of rice price hikes on poverty and food security vary among countries and among households within a country. Nationally, the effects depend on whether a country is a net exporter or a net importer of rice. At the household level, the effects depend on whether a household is a net seller or a net buyer of rice and also on the share of rice income to total income of a household. A net exporter or a net seller benefits, whereas a net importer or a net buyer suffers from a rice price hike.

Bangladesh is a net rice-importing country, although import quantity has been declining over the years. Agriculture in Bangladesh is organized around small family farms with fragmented plots. The average farm size is only 0.56 ha [8]. The farm size is further declining because of the growing population and conversion of agricultural land for non-agricultural purposes. Many rice farms face risks of flooding and cyclones in the rainy season and are exposed to salinity and drought in the dry season. The quantity of food produced from these tiny landholdings is just enough to feed an average family size of five, and hence, it can hardly generate any marketable surplus food. The structure of farm holdings is such that more than half of the farm households cultivate less than 0.40 ha each and they lack food self-sufficiency (Table 1). They are deficit in the sense that they are net buyers of rice, even in good harvest years. Another 33%, cultivating an area between 0.4 and 1.0 ha per household, are marginally self-sufficient. In this group, in good years, they produce a small surplus, but they may have to buy rice in bad harvest years. The remaining 15% of farms are surplus producers of rice in both good and bad years. It should also be noted that 27% of total households living in urban areas are net buyers of rice.

The agricultural census survey data of 2008 show that 52% of the total farm households are net buyers of food, 33% are at the threshold level of self-sufficiency, and only 15% are net sellers of food. This indicates that roughly 85% of households in Bangladesh are permanent or temporary buyers of food and only about 15% are net sellers of food. As rice is the most important crop that occupies more than three-fourths of the total cropped area and as 90% of farmers are engaged in rice production, the same conclusion holds true for rice-farming households. These facts and figures indicate that an overwhelming majority (85%) of rice farmers are net rice buyers as opposed to being net rice sellers (15%). These large numbers of net buyers in Bangladesh would be negatively affected, whereas a small number of net sellers would benefit from the increase in rice prices. The urban poor would be more adversely affected as compared with those living in rural areas because all urban poor are complete buyers of rice.

Household consumption expenditure on food by income decile group can shed light on the differential effects of rice price hikes on the poor and non-poor households. Rice is the main food in the Bangladeshi diet, this is more so for the poor as their food consists of rice supplemented by vegetables and other items. Because of food preferences and habits, households try to consume rice even if it is expensive, although they may reduce the quantity and quality of rice when prices rise suddenly. High prices of rice mean lower real income and lower buying power, which would increase vulnerability, food insecurity, and poverty. Bangladeshi households generally spend a large portion of their budget on food. In 2010, the national average share of food expenditure was 55% and that of non-food expenditure was 45%

Table 1. Distribution of farm households, by farm size group, and their food self-sufficiency status, Bangladesh, 2008.

Farm-size groups (ha)	Share in number of total farm households (%)	Share in total land area of rice (%)	Food self-sufficiency status of farm	Food marketable surplus status of farm
≤ 0.2	28	4	Deficit farm	Net buyers
0.2—0.4	24	12	Deficit farm	Net buyers
0.4—1.0	33	36	Marginally self-sufficient	Marginally net sellers
1.0—3.0	14	37	Surplus	Net sellers
≥ 3.0	1	11	Surplus	Net sellers

Data source: BBS [1] and authors' calculation.

of the total expenditure of a household (Table 2). The expenditure patterns, by income decile group, show that the expenditure pattern of Bangladeshi precisely follows Engel's law, that is, low-income households spend more on consumption of food items than rich households. The bottom 20% income decile group households spent as high as 70% on food, while the top 20% income decile group households spent 47% on food. Thus, the overall food budget share of the poorest group of households (i.e., those at the bottom 20% income decile) was about 50% higher compared with those belonging to the richest households (i.e., the top 20% income decile). The food expenditure pattern across income groups was virtually the same between 2005 and 2010, but, the food expenditure share in 2010 was 2% higher than in 2005 because of the higher food prices in 2010. Increased food prices caused increased expenditure on food items. While rich households can easily manage extra expenditure, it is comparatively hard for poor households to do so. Poor households resort to various short-term and long-term strategies to manage the extra income required to maintain their normal food consumption. Such smoothing of consumption strategies is likely to bring long-term consequences on livelihoods and they are likely to increase the depth and breadth of poverty.

Table 2. Percentage share of food and non-food items in total consumption expenditure, by income decile group of households, Bangladesh, 2005 and 2010.

Household income decile group	2010		2005	
	Food	Non-food	Food	Non-food
Bottom 20%	70	30	68	32
3rd and 4th	67	33	67	33
5th and 6 th	63	37	64	36
7th and 8th	58	42	60	40
Top 20%	47	53	45	55
Total	55	45	54	46

Source: BBS[10] and authors' calculation.

Table 3 presents the share of rice in total food expenditure, by income group of households. The lowest income group, on average, spent 38% of their food budget on rice. For the lowest income group, the share of rice in the food budget is significantly higher in rural areas (41%) than in urban areas (29%). The share of rice in the food budget declined progressively for higher income groups. This supports the argument on decreasing income elasticity of demand for rice, but the absolute amount of expenditure on rice increases progressively along with the rise in income. Lower consumption but higher expenditure on rice for the high-income group relative to the low-income group indicates that the high-income group consumes higher quality and more expensive rice (Fig.6). High-income households devote a much smaller share of their food budget on rice and thus relatively suffer less from rice price increases when compared with households in the lowest income group. While it is possible for rich households to make some reductions in rice consumption by switching to non-rice food, low-income group households cannot make large reductions in their consumption because they live closer to subsistence levels. As such, poor households bear almost all of the shock from high rice prices. Again, high food prices reduce the real income of low-income groups; there is little money left after purchasing food to consume other necessary goods and services such as education, health, fuel, and energy. In other words, the income effect also hurts the poor more. Thus, higher rice prices adversely affect the welfare of low-income groups because they have no substitute for food and their real income is reduced.

At the national level, we know from the 2007-2008 price crises that higher rice prices not only fuel inflation but also create economic and social unrest. For rice-importing countries, it raises import bills, worsens the balance of payment, threatens foreign exchange reserves, lowers economic growth and development, and increases budgetary outlays to provide safety nets for poor consumers [16]. Higher rice prices pose a unique challenge to developing countries dependent on rice imports. For exporting countries, higher rice prices can increase government revenues and augment economic growth.

Impact of rice price hike on poverty: Empirical studies have shown that high rice prices generate a strong negative effect on poverty. Since low-income households and developing countries spend relatively a larger portion of their income on food, higher food prices hurt them more. Among the poor, it is the landless, the female-headed households, and the urban poor that are most vulnerable to the sharp rise in basic food prices [17]. Generally, the poor have a less diverse diet and less expensive food. In the short-run, they try to cope with food price hikes by reducing both the quantity and the quality of food they consume, worsening their food insecurity and malnutrition. In the long-run, they try to cope with higher food prices by selling productive assets and by minimizing expenses on education and health. The ultimate effects of such erosion of physical and human capital on the livelihood

Table 3. Household expenditure patterns on major food items, by income group, Bangladesh, 2010 [10].

Household monthly income group (Taka)	Share of monthly expenditure on major food items (%)							
	Rice	Non-rice cereals	Fish	Pulses	Meat and milk	Oil and fat	Vege-tables	Miscella-neous
<1,500	38	3	13	2	9	6	11	18
1,500-3,000	40	3	12	2	8	5	11	19
3,000-6,000	38	4	11	2	9	5	11	20
6,000-10,000	34	4	13	2	11	4	12	20
>10,000	25	4	15	3	17	4	12	19
All groups	34	4	13	2	11	4	12	19

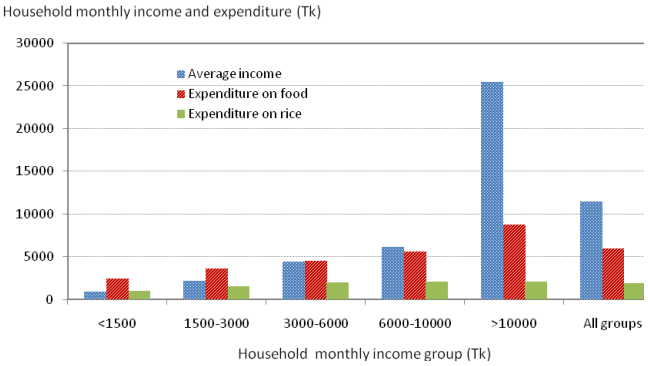

Figure 6. Monthly consumption expenditure on rice and food, by household monthly income group, Bangladesh, 2010 [10].

of the poor are colossal. High rice prices make vulnerable people poor and hungry. The transmission of global rice price hikes hit a range of countries and Bangladesh is one of them. Globally, the escalated food prices of 2007–2008 pushed an estimated additional 80 million people into hunger [17]. They not only increase but also deepen poverty and food insecurity, leading to irreversible harm.

We used 22 years (1988–2010) of panel-household survey data from Bangladesh to analyze the impact of rice price hikes on poverty. The analysis of panel data showed that rural poverty rate declined significantly from 57% in 1988 to 44% in 2004—a 13-percentage point reduction in poverty in 16 years (Table 4). However, the long-term declining trend in poverty started to reverse in the mid-2000s, and poverty incidence increased from 44% in 2004 to 50% in 2008 and 46% in 2010. The reversal of the long-term poverty trend in 2008 can be largely attributed to the rise in rice prices in 2007–2008. In other words, the recent increase in food prices pushed down an additional 6% of the population below the poverty threshold. This means that an additional 9 million people fell into the poverty trap because of the food price hikes in 2007–2008. By accounting for 34% of the food budget, the rice price hike was a major driver of the increase in poverty. Many years of efforts to reduce poverty is trounced by one episode of a price spike. Between 2004 and 2008, moderate and extreme poverty incidences rose by 5% and 1%, respectively. Poverty measures, including the poverty gap index and severity, reflect not only the incidence but also the severity of poverty in households; these worsened generally because of the spike in prices. The poverty gap index, which measures the depth of poverty and was estimated at 21% in 2008, had a record increase of 3 percentage points since 2004. This increase in the poverty gap indicates that the average consumption level of the people living below the poverty line decreased from 2004 to 2008. The poverty gap ratio squared, which measures the severity of poverty, increased by 1 percentage point between 2004 and 2008. The different estimated poverty measures indicate that the increase in rice price resulted in the increase of incidence, depth, and severity of poverty in Bangladesh. The relatively lower poverty rate in 2010 compared with 2008 can be attributed to the lower rice prices in 2010 than in 2008 (see Fig. 2).

Table 4. Incidence of poverty, poverty gap, and poverty gap squared of households, 1988-2010.

Poverty indicator	1988	2000	2004	2008	2010
Poverty ratio (%)	57	51	44	50	46
Moderate poverty	27	29	25	30	26
Extreme poverty	30	22	19	20	22
Poverty gap (%)	23	20	18	21	21
Poverty gap squared (%)	12	11	10	11	13

Data sources: IRRI [7] and authors' calculation.

Drivers of rice price hikes: A thorough understanding of the underlying driving forces of the higher price of rice is vital to creating appropriate policies, safety nets, investment decisions, or emergency interventions that help mitigate the effects of high rice prices. These driving forces are many and complex and they include factors from both the demand and supply sides. Long-term structural changes underlying growth in demand for food, in tandem with short-term temporary or cyclical factors that adversely affect rice supply, resulted in demand exceeding supply. A reduced level of marketable surplus and a tight balance between demand and supply of rice contributed to the upward pressure on the price of rice. Three recent episodes of price hikes were largely based on the simple premise of economics: prices increase when demand and supply become tighter, either because of the rise in demand or fall in supply. Price changes in rice are usually influenced by the level of local marketable surplus, although international prices also play an important role. In the following section, we discuss a catalogue of demand and supply factors that caused an upward pressure on the price of rice in the past few years in Bangladesh.

Domestic factors on the demand side

Population growth: Bangladesh is one of the most densely populated countries in the world. In this country, each year, 1.8 million additional rice consumers are added to a population of 150 million. The continuously growing number of people increases the demand for rice.

Consumption pattern: Bangladesh has been witnessing rapid and

sustained economic growth and increased urbanization. As the purchasing power of millions of people has increased, so has their overall demand for rice, especially high-quality rice. The income elasticity of demand for rice in Bangladesh has been estimated at 0.20 [18]. This means that a 1% increase in income will raise demand for rice by 0.2%. Higher wealth and urbanization have also led to changes in diet, especially to higher consumption of meat, fish, and dairy products, which are heavily dependent on cereal inputs. The own-price elasticity of demand for rice in Bangladesh is estimated at -0.12 [19]. This means that an 1% increase in the price of rice will reduce demand for rice by 0.12%. The authors also reported a significantly lower price elasticity in the demand for rice among the high-income group (-0.003) vis-à-vis the low-income group (-0.25). This implies that the demand for rice by the high-income group is not sensitive to the market price of rice. In other words, rich consumers are less likely to reduce their consumption even if rice prices go up. These evidences in income and price elasticity indicate that the continued strong economic growth in Bangladesh may push food prices upward, especially the price of high-quality rice.

Domestic factors on the supply side

Rice stocks: The national rice stock levels have decreased more in recent years compared with those in earlier years mainly because of the decrease in marketable surplus (Fig. 7). Lower stock levels contributed to higher and more volatile prices because of uncertainties on the adequacy of supply during shortfalls in production.

Climate change-led production shortfalls: Extreme weather events such as droughts, floods, and cyclones caused production loss and variability in the supply of rice. For example, a very severe flood in 1998 and a very severe cyclone in 2007 caused huge damage on the rice crop, thereby compelling the country to import a huge amount of rice during the years that followed those (Fig. 7). A growing concern over the potential effect of climate change on the availability of food supply in the future has aggravated this fear.[20]

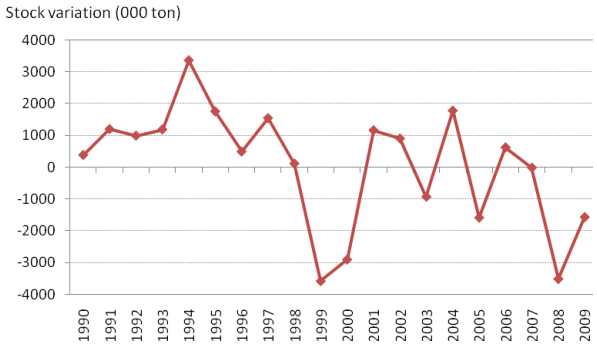

Figure 7. Paddy rice stock variation in Bangladesh, 1990-2009 [11].

Energy prices: International and national fuel prices rose rapidly and steeply in the last decade. For example, the diesel price in Bangladesh increased by 325% from Taka 16 per liter in May 2000 to Taka 68 per litre in January 2013. Fuel prices and food prices are positively correlated. The rapid increase in fuel prices pushed rice prices up by raising the cost of fertilizer, transportation, and irrigation [6]. High input prices have direct adverse effects on the cost of production, input use, yield, and output prices.

Labor cost: Labor cost accounts for 46% of the total cost of rice production in Bangladesh [8]. The daily wage rate of male agricultural laborers in Bangladesh increased by 450%—from Taka 63 per day in 2000 to Taka 280 per day in 2013 [7]. This large increase in labor cost raises rice production cost, which in turn raises the price of rice.

Low profitability: Low output prices but rising production costs resulted in low profit from rice production compared with other agricultural enterprises. As a result, farmers shifted from rice to more profitable non-rice crops [21]. This has affected the rice supply and rice prices.

Regional trade policies: Bangladesh imports rice from India, thus, any change in rice trade policies in India has a direct impact on Bangladesh. To contain soaring rice prices, India put an export ban on rice in 2007–2008 [6]. This created panic in Bangladesh rice markets, pushing rice prices up.

Global factors

International price transmission: Price changes in international markets easily get transmitted into the domestic market [16]. In recent years, several factors pushed the international rice price up, which, in turn, mirrored Bangladesh's domestic price. During 2001-2010, rice production grew at a good rate at 3.7% per year, compared with 3.3% from 1991 to 2000. Yet, prices continued to rise in response to rising world prices. It appears that trends in rice prices have been linked not only to domestic production and availability but also to international markets [6]. With this, the correlation between rice prices in Calcutta-Dhaka and Thailand-Dhaka has been reported to be 0.9 and 0.8, respectively, implying that they tend to move closely together [4]. Major factors that escalated global rice prices include the growing demand for rice in Asia and Africa, rising prices in global commodity, evolution of global food commodity markets, commodity price speculation, exchange rate volatility, and other macroeconomic factors [22].

Trade policies: In an attempt to minimize the effect of higher food prices on vulnerable groups within countries, most governments have intervened with food markets, which, in turn, exacerbated food prices in international markets. For example, Vietnam imposed an export ban in September 2007 and India imposed an export ban, as well as raised a minimum support price for rice in October 2007[2]. Export restrictions and bans on major rice-exporting countries have reduced global supplies, aggravated shortages, and eroded trust among trading partners [23]. Speculative pre-stocking or re-stocking by large importers, such as the Philippines and Bangladesh, has also contributed to higher prices [24].

Financial markets: The turmoil in traditional asset markets is believed to have had some impact on food prices as new types of investors have participated in derivative markets based on agricultural commodities. Global trading activity in combined future and option markets has more than doubled in the past decade [24]. Some analysts believe that this high-level speculative activity in agricultural commodity markets is an important driving force to soaring food prices [24, 25].

Exchange rates: Changes in foreign currency exchange rates, particularly those of exporting countries, influence rice prices in importing countries [26]. For example, the exchange rate of the Thai baht to the US$ appreciated by 31%, whereas the Bangladeshi taka to the US$ depreciated by 33%.

The rapid growth of the middle-class society in Asia, inelastic price elasticity of demand in rice, scarcity of natural resources used in rice production, rising prices of inputs for rice production, and increasing intensity of climatic natural disasters suggest that rice prices are less likely to drop significantly from current levels. Countries with a high incidence of poverty and food insecurity will bear the brunt of high rice prices and hence, they must prepare to cope with the adverse effects.

Household-coping mechanisms: Poor and vulnerable households use various income and consumption smoothing strategies to cope with higher rice prices. The coping strategies of the poor and vulnerable households include, but is not limited to, migration, working harder, eating less, eating less nutritious and uncommon food, reducing the number of meals, buying cheaper food, growing their own food and purchasing less from the market, eating less outside the home, living more frugally, drawing down any resources and assets, borrowing loans, managing finances on a day-to-day basis, cutting down on health and education expenses, and taking children out of school [18, 27-29]. Poor households considerably changed the quantity and quality of food consumed to smooth-out consumption patterns as reflected in the food consumption patterns of the extremely poor during the rice price hike [30]. Such coping strategies, however, vary across income groups and members within a family. Miah *et al.* [30] reported that poor households in Bangladesh adopted a range of food- and non-food-based strategies to cope with higher prices of food, particularly rice. The common food-based coping strategies of the poor households were to cut down the number of meals per day, cut down the amount of meals per food, consume lower quality cheaper rice, or mix rice with varieties of non-rice items to increase the quantity of food. The same study found that more than 85% the poor households in Bangladesh adopted one or more such food-based coping strategies during the rice price hikes. These food-based short-term coping strategies would reduce nutrient and calorie intake with ultimate long-term consequences on the development of human capital, particularly on physical and mental growth, health, and nutrition of family members.

In response to the food price hikes of 2007-2008, the poor households in Bangladesh adopted a wide range of non-food coping strategies [30].The most common non-food coping strategies were cutting down medical and clothing expenses; deferring house repairs; borrowing money; changing occupational strategies, such as working in non-farm sectors and working more days; and selling personal assets (Table 5). Other non-food coping strategies were seeking jobs, taking additional work, seeking jobs outside their areas, minimizing recreational or leisure expenses, and reducing educational expenses. These non-food coping strategies have long-term implications on the livelihood of the poor.

The facts and figures presented proved that food price hikes adversely affect food consumption, medical treatment, and other important expenses of poor households, but who among family members suffer the worst? Miah *et al.* [30] found that more than 85% of households reduced their number of meals, cut expenses

Table 5. Non-food-based coping strategies of the ultra-poor during the price hike in Bangladesh, 2008 [30].

Non-food-based coping means	Ultra-poor households (%)
Cutting down on medical expenses	90
Cutting down on clothing expenses	89
Deferring house repairs	79
Borrowing money	71
Changing occupation	49
Selling assets	47
Cutting down on education expenses	31
Stop sending children to school	5

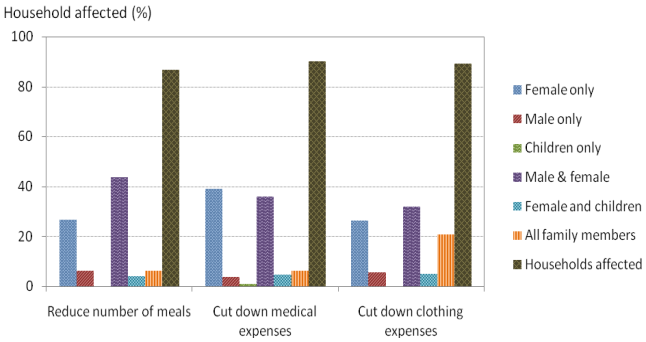

Figure 8. Coping strategies of ultra-poor households, by type of members, during the price hike, 2008 [30].

on medical treatment, or cut down on clothing expenses to cope with higher food expenditure (Fig. 8). Within individual households, it is mostly the adult females who suffer most from the adoption of such coping mechanisms. Frequency of meals consumed differs significantly among family members. Adult females sacrificed their food consumption more than adult males in favor of other members. In a separate study, 58% of respondents reported that females consumed fewer meals than other household members during the food price hikes of 2007-2008 [31].The same study also reported that female-headed households take their meals less frequently than do male-headed households. Cutting down on medical expenses was also highest among adult females (Fig. 8). It was reported that socio-cultural practices and economic factors caused more suffering for females. The bigger sacrifice on the part of the female is usually justified on the grounds that, since males are engaged in various income-earning activities, they are given relatively more food by the females (mainly housewives). Also, priority is given to preserving the health of males so that they could get more energy to do continuous or more work and could earn more income for their family. The likely adverse health effects of the adjustment in food consumption and medical treatment patterns of females are an issue of concern, particularly for pregnant women and those who have recently given birth. A pattern similar to what was observed in food consumption and medical expenses are also observed in clothing, with females faring worse than their male counterparts.

Sulaiman *et al.* [32] compared coping strategies of different income quintile groups of households during the 2007-2008 rice price hikes in Bangladesh. The study found significantly different coping strategies across the quintile groups (Table 6). The main coping

Table 6. Percentage of households, by income quintile group, that adopted different coping strategies to rice price rise, Bangladesh, 2008 [32].

Means of coping	Poorest quintile	2nd quintile	3rd quintile	4th quintile	Richest quintile
Consumption smoothing using credit					
Borrowing from informal sources	13	14	12	9	4
Borrowing from formal sources	22	21	19	13	6
Food consumption strategies					
Reduce number of meals	39	23	17	5	2
Reduce quality of meals	88	72	62	45	21
Reduce quantity of meals	70	49	45	25	10
Consume non-staple foods	37	22	14	8	5
Non-food consumption strategies					
Reduce fuel expenses	33	19	16	18	10
Reduce health expenses	18	26	28	26	20
Reduce clothing expenses	78	72	73	73	77
Reduce transport expenses	11	11	12	9	18
Reduce education expenses	2	6	4	2	2

mechanisms were reducing quantity and quality of food consumption, reducing non-food expenditures, borrowing loans from formal and information institutions, and using social safetynet programs. The study showed that poorer households are more likely to adopt a wider range of both food and non-food coping strategies, whereas richer households are more likely to adopt non-food coping strategies. It is evident that the poor bear the disproportionately higher brunt of the rice price hikes.

Conclusions and Recommendations

Rice price has followed an upward movement since 2001 and drastically spiked in three occasions in the last 7 years. Higher rice prices are likely to persist and continue to challenge the ability of consumers and governments to cope with the consequences. Roughly 85% of households in Bangladesh are net buyers of rice. A typical Bangladeshi household spends 34% of its food expenditure on rice, which is as high as 38% for the poor. Therefore, the impact of rice price hikes on poverty and food security is undoubtedly substantial in Bangladesh. The impact is disproportionately high on low-income groups, and hence, the poor are most vulnerable to rice price hikes. The 2007-2008 food price hikes increased poverty rate by 6% and pushed an additional 9 million people below the poverty threshold in Bangladesh. The price hikes also increased the depth and severity of poverty. Most of this poverty impact was due to the increase in rice prices. Households adopted various consumption and income mechanisms in response to the high food prices. The households' coping strategies include reducing the quantity and quality of foods consumed, cutting expenses on health and education, borrowing loans, and living more frugally. Women suffer most while adopting these coping strategies. The forced reduction of expenses on these necessities can have long-term consequences on human capital development, poverty, and livelihood.

Broad-based short-, medium-, and long-term strategies are suggested to contain sharp increases in the price of rice in the future and to minimize its adverse effects on the poor. Short-term strategies should focus on managing risks and mitigating the impact of high rice prices through better access to food and safety net programs. The government must help vulnerable groups through targeted safety net programs such as provision of subsidized food, school feeding programs for children, cash and asset transfers, etc. This requires stocking adequate rice supplies for emergencies, effective institutional mechanisms capable of providing timely services, identification of target groups, and timely delivery of rice to the needy.

In the medium term, the focus should be on improving rice productivity by disseminating modern production technologies; developing rural infrastructure, including reliable and expanded irrigation systems; bringing ecologically suitable fallow areas under cultivation; reducing postharvest losses; strengthening extension services; improving marketing services; providing quality seed through public-private partnerships; and ensuring rural financial services. The government should develop adequate infrastructure and marketing system that ensure the efficient flow of products. Efficient marketing systems that reduce marketing costs can benefit both producers and consumers without increasing prices. Developing a pricing model that specifies a price band in annual prices and links this band to seasonal prices, keeping in view both cost and price stability, would help stabilize rice prices.

A catalogue of long-term strategies can be adopted to minimize rice price hike in the future. First, increase investment in rice R&D with strong focus on climatic stress-tolerant rice varieties to improve productivity. One major cause of a recent rice price hike is the reduced marketable surplus of rice due to stagnation of rice yield in the past two decades. Moreover, climatic factors have caused large variability in rice yields. New public and private partnership in agriculture is warranted, including increased funding on rice R&D for the private sector. Second, the inputs to rice

production such as land, water, labor, and capital are not only degrading, but also facing competition from other sectors and becoming costly. Higher price of input means higher cost of production and higher output prices. High food prices can be considered an opportunity to improve efficiency in rice production systems. The government can promote improved technologies that increase input-use efficiency and thereby help reduce costs of production. Third, shocks in supply are increasingly becoming more important than shifts in demand as a source of price variability in Bangladesh. Government action on managing the supply side should focus on diminishing price variability. To do this, a timely mechanism in responding to any dramatic shortfall in production (for example, crop loss from drought and flooding) should be developed and put into action. Besides, an effective price stabilization program for rice should also be put in place to reduce the seasonal volatility of rice prices and also to protect the interests of local producers and consumers. A twofold challenge for the government is to keep prices of staple food within an accessible limit for the poor and to provide a fair price for local farmers. The government has used ration distribution, open market sales, and postharvest procurement strategies to keep prices from rising abnormally. Creating buffer stocks of rice, particularly in disaster-prone areas, could be another option to mitigate the impact of natural disasters and to intervene in food markets when needed. Nevertheless, intervention in food markets through buffer stocks involves various costs, including maintaining the stocks, efficiency in implementation, and distortion in the market. Therefore, it should be limited to containing extreme fluctuations in price and supply. Fourth, coordinating imports through a national stocking policy is vital in any rice price policy program in Bangladesh. Imports can provide long-term and location-specific responses to food-grain deficits. Finally, other long-term potential strategies that help contain increases in rice price include trade (import and export) strategies; rice production monitoring and forecasting systems; transparency in future markets and tighter regulation of speculation; land-use policies; and accurate information on demand, supply, and stock situations that encourage diversification in the diet and promote sustainable production systems.

References

[1]BBS (Bangladesh Bureau of Statistics) 2010. Census of agriculture 2008: structure of holding and livestock population. Volume 1: Report on national series. BBS, Dhaka, Bangladesh.

[2]Pandey, S., Rosegrant, M.W., Sulser, T. and Bhandari, H. 2010. Rice price crisis: causes, impacts, and solutions. Asian Journal of Agriculture and Development **7**(2):1-15.

[3]ADB (Asian Development Bank) 2011. Global food price inflation and developing Asia. ADB, Manila, Philippines.

[4]World Bank 2012. Transmission of global food prices to domestic prices in developing countries: why it matters, how it works, and why it should be enhanced. Contribution from the World Bank to the G20 commodity markets sub working group. The World Bank, Washington, D.C., USA.

[5]World Bank 2014. The commodity price data of the World Bank. Available online at www.worldbank.org.

[6]Hossain, M. and Deb, U. 2010. Volatility in rice prices and policy responses in Bangladesh. In Dawe, D. (ed.). The Rice Crisis: Markets, Policies, and Food Security. Earthscan, Washington, D.C., USA, pp. 91-108.

[7]IRRI (International Rice Research Institute) 2013. The Bangladesh panel household survey database of 1988, 2000, 2004, 2008, 2010. IRRI, Los Baños, Philippines.

[8]Hossain, M. and Bayes, A. 2009. Rural Economy and Livelihoods: Insights from Bangladesh. A. H. Development Publishing House, Dhaka, Bangladesh.

[9]Foster, J., Greer, J. and Thorbecke, E. 1984. A classic decomposable poverty measures. Econometrica **52**(3):761-766.

[10]BBS (Bangladesh Bureau of Statistics) 2011. The household income and expenditure survey report 2010. BBS, Dhaka, Bangladesh.

[11]FAO (Food and Agriculture Organization of the United Nations) 2013. FAOSTAT statistical database. FAO, Rome, Italy. Available online at http://faostat.fao.org.

[12]Gaiha, R., Kaicker, N., Imai, K. S., Kulkarni, V. S. and Thapa, G. 2012. Diet diversification and diet quality in India: An analysis. Research Institute for Economics and Business Administration (RIEB) Discussion Paper Series 2012-30. Kobe University, Kobe, Japan.

[13]Khush, G. S. 1999. Green revolution: preparing for the 21st century. Genome **42**(4):646-655.

[14]DAM (Department of Agricultural Marketing) 2013. Online and published agriculture commodity prices data of Bangladesh, various years. Department of Agricultural Marketing, Ministry of Agriculture, Government of the People's Republic of Bangladesh. DAM, Dhaka, Bangladesh. Available online at www.dam.gov.bd.

[15]Bangladesh Bank. 2013. Monthly economic trend: Consumer price index and inflation rate in Bangladesh, various years. Statistics Department, Bangladesh Bank, Dhaka, Bangladesh. Latest data available online at www.bangladesh-bank.org.

[16]Dawe, D. (ed.) 2010. The Rice Crisis: Markets, Policies, and Food Security. Earthscan, Washington, D.C., USA.

[17]FAO (Food and Agriculture Organization of the United Nations) 2008. The State of Food Insecurity in the World 2008: High Food Prices and Food Security – Threats and Opportunity. FAO, Rome, Italy.

[18]Begum, M. E. A. and D'Haese, L. 2010. Supply and demand situations for major crops and food items in Bangladesh. Journal of Bangladesh Agricultural University **8**(1):91-102.

[19]Ahmed, A. U. and Shams, Y. 1994. Demand elasticities in rural Bangladesh: An application of the AIDS Model. The Bangladesh Development Studies **22**(1):1-25.

[20]Basak, J.K. 2011. Climate Change Impacts on Rice Production in Bangladesh: Results from a Model. Unnayan Onneshan-The Innovators, Dhaka, Bangladesh.

[21]Bhandari, H. and Mohanty, S. 2012. Poverty and income situation in Bangladesh: Results of household survey 2009 and 2010. A paper presented at the Village dynamics in South Asia Project half-yearly review meeting, 5-6 March 2012, Dhaka, Bangladesh. IRRI, Los Baños, Philippines.

[22]Dawe, D. and Slayton, T. 2010. The world rice market crisis of 2007-2008. In Dawe, D. (ed.).The Rice Crisis: Markets, Policies, and Food Security. Earthscan, Washington, D.C., USA, pp. 15-28.

[23]Sarris, A. 2010. Trade-related policies to ensure food (rice) security in Asia. In Dawe, D. (ed.). *The rice crisis: Markets, policies, and food security.* Washington, D.C., USA: Earthscan.p. 61-90.

[24]Timmer, P. 2010. Did speculation affect world rice prices. In: D. Dawe, (Ed.), The Rice Crisis: Markets, Policies, and Food Security. Earthscan, Washington, D.C., USA, pp. 29-60.

[25]Lagi, M., Bar-Yam, Y., Bertrand, K.Z. and Bar-Yam,Y. 2011. The food crises: amuantitative model of food prices including speculators and ethanol conversion. arXiv:1109.4859.

[26]Catao, L.A.V. and Chang, R. 2013. World food prices, the terms of trade-real exchange rate nexus, and monetary policy. International Monetary Fund (IMF) Working Paper No. WP/13/114. IMF, Rome, Italy:

[27]Lustig, N. 2009. Coping with rising food prices: Policy dilemmas in the developing world. Working Paper Number 164. Centre for Global Development, Washington, D.C., USA.

[28]Reyes, C.M., Sobrevinas, A.B., Bancolita, J. and Jesus, J. 2009. Analysis of the impact of changes in the prices of rice and fuel on poverty in the Philippines. Philippine Institute for Development Studies (PIDS). Discussion Paper Series No. 2009-07. PIDS, Manila, Philippines.
[29]D'Souza, A. and Jolliffe, D. 2010. Rising food prices and coping strategies: Household-level evidence from Afghanistan. Policy Research Working Paper 5466. The World Bank, Washington, D.C., USA.
[30]Miah, T. H., Mandal, S., Haque, M. M., Sanni, S. A. and Palash, M. S. 2010. Livelihood Adaptation of Disadvantaged People of Bangladesh to Economic Vulnerability and Other Shocks. Final Report for the National Food Policy Capacity-Strengthening Programs. Bangladesh Agricultural University, Mymensingh, Bangladesh.
[31]FAO and WFP (Food and Agriculture Organization of the United Nations and World Food Program) 2008. FAO/WFP Crop and Food Supply Assessment Mission to Bangladesh: A Special Report. FAO, Rome, Italy.
[32]Sulaiman, M., Parveen, M. and Das, N. C. 2009. Impact of the Food Price Hike on Nutritional Status of Women and Children. Research Monograph Series 38. BRAC Center, Dhaka, Bangladesh.