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Is Seasonal Hunger a Distant Memory in Bangladesh? Revisiting Earlier Evidence

Shahidur R. Khandker[*] and Hussain A. Samad[†]

Abstract

While seasonality of income, consumption and poverty is not uncommon in rural Bangladesh, it is more pronounced in the Rangpur region, where it is exacerbated by the region's agroecology and adverse economic geography. This paper, using three rounds of nationally representative data from household income and expenditure surveys from 2000-2010, follows up on earlier findings based on two rounds of data from 2000 and 2005 (Khandker 2012) to determine the extent and causes of seasonality and the factors that helped to combat the severity of such seasonality. This paper adds value to the earlier study in two ways. First, it examines whether the earlier findings still hold over a longer timeframe. Second, having the benefit of three data points allows us to examine the trends in outcomes and underlying factors. The paper finds that seasonal hunger, often known as 'monga' in the North-West region of Bangladesh, is caused by both yearly aggregate of income and its seasonal variation. The paper recommends that structural integration of labor, food, and credit markets is necessary to alleviate endemic poverty as well as mitigate the adverse impacts of agricultural seasonality. Combating seasonal hunger therefore calls for diversifying agricultural and rural incomes as well as enhancing poor households' capacity to insure against seasonality.

Keywords: seasonality of income; seasonality of consumption; rural poverty; crop cycle; Bangladesh

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1. Introduction

Seasonal hunger, induced by agricultural seasonality, is a common feature of rural poverty in many developing countries. In many parts of the developing world, agricultural diversification made through technological breakthroughs has reduced the extent and severity of seasonal stress and adversity. Yet in certain agricultural settings of Africa and Asia, seasonality of hunger has persisted for several reasons. First, given the seasonality of major food crops (e.g., wheat, rice, and maize), a crop failure event or poor harvest intensifies seasonal stress. Second, seasonality is more pronounced in economically depressed and ecologically vulnerable areas. Any irregular occurrence, such as flooding or lack of the monsoon rains, can magnify adverse seasonal consequences, with irreversible effects on livelihood. Finally, extreme weather conditions associated with climate change can result in increased frequency, intensity, and unpredictability of seasonal income and consumption shocks. If not checked early enough, seasonal hunger may lead to famine.

It is not a surprise therefore that the poor are most at risk of food insecurity. However, discourses on food insecurity tend to overlook seasonal hunger, in part, because it is "missing" from official data collection processes and the analyses that calculate and annualize poverty numbers (Longhurst, Chambers and Swift 1986). There is no direct account of how many of "the bottom billion" suffer from seasonal hunger (Collier 2007). More than 80 percent of the world's poor live in rural areas and are dependent on agriculture for their livelihood (Khandker and Mahmud 2012, 1). Another reason for inaction is the lack of understanding of the complex, mutually reinforcing dynamics of the poverty cycle and its seasonality.

The costs of ignoring seasonal hunger can be enormous. Various studies indicate that a much larger number of rural households may be vulnerable to food insecurity than standard poverty statistics suggest; that is, a portion of the non-poor, as measured in annual data, may in reality be seasonally poor because they cannot maintain consumption above the poverty line consistently throughout the year, and in particular, in response to seasonal shocks (see, e.g., Dercon and Krishnan 2000). Also, a household that is poor year-round is likely to be poorer during the lean season. The poverty gap index, the official statistical measure of the intensity of poverty, does not capture this phenomenon and thus underestimates the severity of poverty. This suggests that policies aimed at reducing poverty, which are based on annual consumption data, may overlook the seasonal dimension of poverty if the causes of seasonal poverty differ from those affecting year-round poverty. Even if the policies are relevant, lack of data may make it difficult to monitor the efficacies of such policies and programs. This may increase the risk that seasonal hunger will lead to endemic poverty if the former causes irreversible adverse effects on income and consumption. Even worse, regions prone to severe seasonality of hunger attract lower public investment than is necessary to create a more diverse and resilient local economy, thereby breaking the cycle of seasonal poverty.

Unless specifically addressed, the seasonal dimension of extreme poverty and food insecurity is likely to persist in a large part of the developing world. Indeed, it can be argued that most of the world's acute hunger and malnutrition occurs during the annual hunger season—the time of year when the previous year's (season's) harvest stocks have declined, food prices are high, wages are low, credit access is limited, and jobs are scarce. In economically depressed or ecologically vulnerable areas in particular, a crop failure or poor harvest can easily transform seasonal adversity into a disaster. Controlling seasonal hunger—aptly referred to as the "father of famine" or the "cycle of quiet starvation"—is thus a step toward averting famine (Devereux, Vaitla, and Swan 2008). Seasonality-related issues require renewed attention given the threat of emerging climate-related risks (e.g., extreme weather conditions) to global food security and livelihood of the poor, which may result in seasonal shocks that are more frequent, severe, and unpredictable. Therefore, the interlocking dynamics of poverty and seasonality must be studied in the context of livelihood strategies extending beyond a particular season or year.

Agricultural seasonality-induced hunger is often intensified by crop failure, poor harvest, and extreme weather conditions. However unlike famine, seasonal hunger may not be visible enough to create a public outcry, while it can have irreversible long-term effects on children's health and growth, as well as the productive life of adults. These "ratchet" effects may also result from the various coping strategies poor households adopt in order to survive, such as mortgaging or selling their land and other assets and making advance sale of crops and labor.

In addition to agricultural seasonality, the underlying differences in agroclimate and ecological endowments, as well as local economic diversity, may influence seasonality of income and consumption. For example, river erosion and frequent floods can create conditions of continuous vulnerability to income and consumption seasonality for a large segment of the population in a region with poor agroclimate and ecological endowments. Since annual poverty measures may not capture the effects of seasonal shortfalls on general poverty, annual monitoring of national or regional poverty may not suffice in developing specific policies needed to address seasonal hunger. Similarly, although regional poverty is context specific, it may be reinforced by seasonality of agriculture; that is, seasonality of poverty, in turn, can reinforce regional poverty, meaning that regional poverty and seasonal poverty may be interlocked.

Bangladesh's success in reducing poverty has been remarkable; the most recent estimates show that the nation's overall poverty rate declined from 40.0 percent in 2005 to 31.5 percent in 2010 (BBS 2011). However, data analysis reveals that the country has not done well in dealing with seasonal poverty and hunger. With sustained growth in food production and a good record in disaster risk management, famine is often viewed as a phenomenon of the past. Yet many rural residents still confront the annual problem of seasonal hunger, locally known as monga (Khandker and Mahmud 2012). Some 70 percent of the country's nearly 160 million people live in rural areas, where life revolves around the so-called rice economy. Although the growth of nonfarm activities has resulted in an increasingly diversified rural economy, the livelihoods of nearly three-fifths of rural workers—and about half of the country's entire workforce—still rely on the agriculture sector.

Because so many Bangladeshi households depend on an agriculture-based income, it comes as no surprise that crop seasonality adversely affects income, consumption, and poverty (Khandker 2012). Given the country's vulnerability to natural disasters and extreme weather-related events (e.g., floods, cyclonic storm surges, and drought), one might also expect seasonality of income and consumption. Recent studies confirm the pronounced seasonal feature of poverty and food deprivation in Bangladesh, with higher incidence of seasonality of poverty found in the northwest region of Rangpur (Khandker 2012; Khandker and Mahmud 2012; Mahadevan, Takamatsu, and Yoshida 2012). This region is well documented in the famine literature, having been among the worst hit regions during the Great Bengal Famine of 1942–44 and the epicenter of the nation's 1974 famine. Since that time, Bangladesh's poverty has declined substantially overall, but progress in poverty reduction has not been uniform across regions. Data from the 2000 and 2005 Household Income Expenditure Surveys (HIES) and Khandker (2012) show that the northwest region has not only fallen behind other regions in poverty reduction; it has also remained particularly vulnerable to seasonal hunger, or monga.

The most recent HIES (HIES 2010) offers a unique opportunity to revisit the earlier evidence of seasonality of income and consumption and determine whether the seasonality of hunger is a distant memory in Bangladesh. That is, the paper examines whether the past trend of pronounced seasonality of income, consumption, and poverty persisted disproportionately in the northwest region of Rangpur. Specifically, the survey data can help determine whether seasonality of income means seasonality of consumption and poverty, as found in an earlier study based on previous HIESs (Khandker 2012). It can also help to identify which factors, if any, have played a role in reducing seasonality of income and whether they have reduced seasonality across regions. Finally, the most recent survey data can be used to identify which policy changes are necessary to alleviate, if not eliminate, the severity of seasonality and its adverse effects on household welfare.

The broad objective of this paper is to analyze the extent and causes of the disproportionate seasonal hunger and year-round poverty that persist in Bangladesh's northwest Rangpur region, using data from the all three rounds of HIES, including 2010. The study also assesses the impact of policy interventions in mitigating seasonal hunger and whether seasonality of income is as pervasive now as in the past.

2. Regional disparity in poverty: Rangpur versus the rest of Bangladesh

Before turning to the seasonal dimension of poverty and its consequences, we first present the regional distribution of aggregate measures of poverty using the recent HIES data over the 10 year period of 2000-2010. The aim is to determine whether the regional trends shown in the measures of poverty have changed over time and across regions. The aim is also to identify whether a certain region may be disadvantaged because of its adverse economic geography and agroecological vulnerability.

The higher incidence of poverty in Rangpur is evident in all three survey years. Rangpur's moderate poverty rate was 70.9 percent in 2000, 56.0 percent in 2005, and 47.9 percent in 2010 (Table 1). These figures were higher than the moderate poverty rate in six other regions for all three survey years. Besides moderate poverty, measures of food poverty and extreme poverty show similar trends – the Rangpur region is the worst during all three years. Thus, while this 10-year period witnessed a fairly rapid decline in poverty levels generally, poverty indices in Rangpur still remain substantially higher than that in other regions. Furthermore, over this period, Rangpur fares worst not only in terms of poverty incidence; it also has the lowest per capita income and expenditure among all regions in rural Bangladesh.

The composition of rural household income provides further insight into why Rangpur households are more vulnerable to seasonal hardship than those in the rest of the country. As Figure 1 shows, households from greater Rangpur do not enjoy as much income diversity as their counterpart households in other regions; rather, they derive most of their income from agricultural sources, which are highly susceptible to agricultural seasonality. Indeed, in 2010, farming comprised about 56 percent of household income in Rangpur, 13 percentage points higher than in the rest of the country. Moreover, income from crops (not reported here), as a share of total income, was higher in Rangpur than in the rest of the country.[1]

In many areas of rural Bangladesh, remittance income from family members working abroad or in the city represents a significant share of household income, as well as a substantial source of inflows of fund into the local economy. However, the exception is Rangpur where remittances were much lower than that in other regions in all three survey years. For example, in 2010 remittances constituted only 4.7 percent of total household income in Rangpur compared to 14.8 percent for rural households in other regions.[2] Notably, the receipt from safety net programs, as a share of total income, while low for the rest of the country, was even lower in Rangpur.

Another concern is that rural households in Rangpur depend more heavily on the agricultural labor market than those households in other regions. For example, Khandker and Mahmud (2012) show that 54 percent of Rangpur's rural people depend on wage employment, versus 16 percent on self-employment, as their main source of income.[3] Although Rangpur households draw a larger share of their income from agriculture, the wage rate in the agriculture sector is considerably less in Rangpur than in the rest of the country.

The severe and persistent poverty situation observed in Rangpur, even in 2010, would probably have improved without the confluence of many adverse factors, including agroclimate ones, as identified by Khandker and Mahmud (2012):

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[1] Crop income is the self-employment income from crop production, and does not include wage income in crop production.

[2] Migration is costly, and in most cases migrant workers exhaust a significant portion of their savings and assets to make trips to the destination countries. So it is not surprising that Rangpur, being the poorest region, has the lowest number of migrants, as was also suggested by a recent study (BBS 2014). Also, it is possible that these migrants, being poor, are mostly unskilled and uneducated, and do not earn enough in destination countries to send large remittances. In fact, a study on the migration in European countries found that as the share of unskilled migrants increases the remittance amount decreases (Schiopu and Siegfried 2006).

[3] These estimates include employment in both farm and nonfarm sectors; excluded are households that earn income from panhandling, remittances, and safety net programs.

- Inadequate investment in infrastructure, resulting in lack of diversification in the rural economy and limited opportunities for nonfarm employment;
- Low crop yields due to poor soil quality (for example, soil is sandy);
- Dependence on wage income by a population that is marginally landless or small landholders;
- Low wage rates in the agricultural sector;
- Risk of floods, river erosion and drought;
- A large population living in char areas, which consist of reclaimed land from rivers, including tiny island-like fragments, making their livelihoods vulnerable; and
- Low remittances from migrant family members working within the country or abroad.

According to a 2006 survey conducted by the Institute of Microfinance (InM), households in Rangpur owned, on an average, only 8.2 decimals of land.[4] Nearly one-fifth of the households surveyed lived in ecologically vulnerable *char* areas—presumably driven by poverty and land scarcity. According to the 2001 population census, the proportion of rural households in the greater Rangpur districts with access to electricity ranged from 4 to 13 percent, compared to 20 percent for the country's rural households overall. The official crop statistics show that the yield of *aman* rice in Rangpur is considerably lower than the national average.

Given that agroclimate and economic forces account for the persistent differences in income and poverty between Rangpur and the other regions, it is plausible to argue that Rangpur's past vulnerability to seasonal food deprivation continues, albeit in hidden form. Within this context, along with our working hypothesis about seasonal hunger, we can examine how much of the poverty observed in Rangpur and other regions in 2010 was due to seasonality of agriculture.

[4] One hundred decimals are equivalent to an acre.

3. Seasonality dimension

3.1 Agriculture

It is assumed that the disproportionate poverty observed in Rangpur, compared with that in other regions, is caused in part by a pronounced seasonality of income, which, in turn, is caused by the seasonality of agriculture. Because of the dominance of rice in crop production in Bangladesh, seasonality of agriculture depends on the timing of rice-crop planting and harvesting, which, in turn, greatly affects levels of crop and income diversification and thus rural livelihoods.

Bangladesh has three major rice crops each corresponding to three crop seasons: *aus* (early monsoon), *aman* (late monsoon), and *boro* (dry season). Over the years, the introduction of modern irrigation, along with high yielding varieties (HYVs), has significantly changed the relative importance of these three rice crops. Previously, transplanted aman was the main rice crop, but today HYV boro accounts for the largest share (about 60 percent) of rice output. The spread of HYV boro rice has also diminished the importance of aus rice because of the overlapping growing period.

As a result of these induced changes in seasonal output patterns, domestic rice production is more uniform, with year-round rice availability and reduced seasonal pricing spreads. Dorosh, del Ninno, and Shahabuddin (2004) note that the pre-harvest price peaks have become bimodal and less marked, thus reducing the extent of the seasonal price spread. In recent years, no systematic change has been detected, except for occasional volatility related to changes in global market prices (Khandker and Mahmud 2012).

Although changes in the rice crop cycle have helped reduce the seasonal spread in rice prices, the characteristics of the traditional lean season preceding the aman harvest (September–November) have changed little. This season features the lowest crop-related activity, with no major crops planted or harvested (Figure 2). Although the wheat-growing season starts in November, the crop is grown on only about 5 percent of the cultivated land. Moreover, the aftermath of natural disasters (e.g., floods, drought, and excessive rains) is usually felt most severely during this season.

Because Bangladesh's cropping patterns are delicately balanced within the natural cycles of rains and annual floods, farmers' production options and their perception of risk are often determined by several key features of the physical environment: (i) degree of seasonal flooding, (ii) timing and quantity of rainfall, and (iii) soil characteristics (Mahmud, Rahman, and Zohir 1995, 2000). Investment in irrigation and flood control, along with improved crop production technology, can alter the cropping patterns by influencing the physical constraints. Thus, some regions may be disadvantaged relative to others because of a lack of investment, along with adverse agroclimate factors.

3.2 Income

The extent of seasonality of income can be shown through a disaggregated analysis of income data by season. Using the HIES data, it is possible to derive estimates by region and season because this survey collects information at various times of the year across regions of the country.[5] For most of our analysis, we divide the country into two regions: (i) Rangpur and (ii) the rest of Bangladesh. Based on the cropping cycle, four seasons are distinguished for the estimates: (i) boro (winter rice), March–May; (ii) aus (early rainfed rice), June–August; (iii) preharvest aman (main rainfed rice), September–November; and (iv) postharvest aman, December–February. In this study, we examine whether household circumstances and their response behavior differ between the preharvest aman season and the other three seasons.[6]

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[5] The HIES divides Bangladesh into 23 geographic regions, one of which is Rangpur. Although different households were interviewed at various times of the year, the data can be used for both inter-seasonal and cross-regional comparisons because of the random sampling of households by seasonal and regional strata.
[6] Throughout this paper, the pre-harvest aman season is referred to as the pre-aman or monga season/period.

Because seasonality of poverty and hunger is a rural phenomenon, we use data from the rural samples of the HIES for years 2000, 2005, and 2010.7 Rural areas, as defined in the HIES, may also include certain semi-urban areas located outside the municipalities. Including such areas is helpful in capturing the seasonality of nonfarm activities, which are often tied to the rhythm of the annual agricultural cycle.

Estimating seasonal income from the HIES data is somewhat problematic in that, for all of the income data collected, the reference period is one year preceding the date of interviews. However, the income from crop production can be sorted out by season because it can be linked to the harvest season for each crop that the households cultivate.[8] This estimate cannot capture income seasonality from other sources (e.g., all wage employment, non-crop agriculture, and off-farm activities); however, it may be taken as a reasonable approximation since the annual crop cycle is the predominant source of seasonality in rural income.

As shown in Figure 3, income experiences a fall in both the aus and pre-aman seasons in all areas of Bangladesh; however, the fall is greater during the pre-aman season, particularly for survey years 2000 and 2005. In addition, such dip in income is more pronounced in Rangpur than in other regions. Furthermore, the seasonal share of household income during the aus and pre-aman seasons is less than 25 percent (the share with uniform distribution of income across seasons) (Figure 4). This income shortfall during the aus and pre-aman seasons is significantly more pronounced in Rangpur, where households not only have less income than those in other regions but also depend on farm income, making them more vulnerable to agricultural seasonality.

[7] The HIES for the year 2000 included a total sample of 7,440 households, of which 5,040 were drawn from rural areas. In 2005, the rural sample was 6,040 out of a total sample of 10,080 households. In 2010, the rural sample was 7,780 out of a total sample of 12,240.

[8] Because the HIES collected households' crop income for each specific crop item, the income distribution by season can be captured as crop harvest time for each crop is known. For simplification, incomes from non-seasonal crops were distributed evenly across four seasons.

3.3 Consumption

The HIES data on household consumption can be estimated by season because the information on food intake was collected for the preceding week for each surveyed household, and data on most nonfood consumption expenditures was collected for the preceding month. For certain durable goods items (e.g., clothing or household utensils), the data refer to one year preceding the interview so that only the annualized estimates for these items can be captured. However, expenditure of these items may have seasonality given that rural households usually spend more on such items during the postharvest season or at the time of annual religious festivals. Nonetheless, it is the seasonality of recurrent types of expenditure for current consumption that is relevant to the analysis of seasonal poverty and hunger. The HIES consumption data are thus particularly suitable for revealing the type of seasonality in household consumption relevant to our analysis.

For all three survey years, monthly food consumption per household is lower in Rangpur than that in the rest of the country, although the difference appears to have declined over time (Figure 5). In survey years 2000 and 2005, there is particularly marked seasonality in food consumption for the country as a whole, especially during the pre-aman season; and this seasonality is more pronounced in Rangpur. In survey year 2010, however, the pre-aman seasonality of food consumption is less pronounced, given that a dip in food consumption occurs during the boro season, as opposed to pre-aman season, for all regions. However, a similar trend in total expenditure can be observed for both Rangpur and the other regions, although an additional dip in the pre-aman season is also observed (Figure 6). In any case, the seasonality of food and total consumption is persistent, and the generally lower level of consumption in Rangpur, along with its seasonality, appears to explain the possible food deprivation in this region. While these findings are similar to those of Khandker (2012), the gap between Rangpur and the rest of the country seems to have declined, particularly in food expenditure. A recent World Bank-supported study using 2008/09 data from the Rangpur region during the pre-aman (monga) season finds that consumption drops as much as 5 percent for the overall population and nearly 10 percent for the poorest 20 percent (Mahadevan, Takamatsu, and Yoshida 2012).

If the dip in food consumption during monga had been accompanied by a seasonal rise in food prices, an even larger decline in food intake would have occurred, and such price increases would have been a further cause of seasonal food deprivation. Using HIES data for survey years 2000 and 2005, Khandker and Mahmud (2012) examined the seasonal price movements for rice, which accounts for half of food expenditure in Rangpur and two-fifths for the rest of the country. Although a seasonal price peak during the boro (pre-harvest) season was observed for all regions in both survey years, prices during the monga season differed little from those in other seasons. Thus, it appears that income seasonality is the primary reason for seasonal food deprivation.

To disentangle food expenditure from prices, we estimate actual per capita caloric intake of food using the 2005 HIES data as an example.[9] As expected, calorie-intake levels are generally lower in Rangpur than in the rest of the country. Also, during the pre-aman or monga season, a clear decline in caloric intake occurs in all regions; however, the Rangpur region exhibits a similar decline in the boro season, suggesting two additional points. First, the seesaw pattern observed in Rangpur means that seasonality of food intake extends beyond the monga (pre-aman) period; that is, there is a fall-off in food intake during the boro (pre-harvest) season and a rise in intake during the aman (post-harvest) season, as well as in the aus season (post-harvest season for boro rice). Second, for relatively poorer households, the extent of the seasonal fall in caloric intake must be significantly greater than the household average (Figure 7). These results are substantiated by a recent study using 2008/09 data, which finds that, while the poorest two-fifths of the population cannot meet the poverty-line daily per capita intake of 2,121 calories at any time of the year, their calorie consumption falls well below 2,000 during the monga (pre-aman) period (Mahadevan, Takamatsu, and Yoshida 2012). The situation is even worse for the poorest one-fifth of the

[9] The methodology of converting food quantities into calories is the same as that used in the official poverty estimates based on the direct calorie-intake method. The HIES reports food consumption by both quantities and expenditures.

population, whose caloric consumption during the monga period drops to about 1,350, which is 36 percent less than required.

In response to income seasonality arising from the crop cycle, the consumption expenditure of rural households is cyclical. Rangpur and the other regions exhibit distinct patterns of income and consumption seasonality. Although monthly expenditure is clearly less than monthly income for some seasons, during the monga period, income in Rangpur, unlike the rest of the economy, either falls short of or very close to consumption (Figure 8).

3.4 Poverty

That seasonality influences both household income and consumption does not necessarily mean that seasonal poverty will result. Similarly, even if consumption seasonality varies by region, it does not indicate how much the poverty level will be influenced by seasonality through either idiosyncratic or aggregate shocks. More specifically, seasonality of income and consumption cannot tell us how many households fall into seasonal hunger or poverty owing to seasonality of the ability to smooth consumption. Assessing that requires examining how seasonality affects households' ability to maintain a minimum livelihood at particular times of year. The question is how many rural households experience a decrease in seasonal income that lowers consumption enough to force them below the poverty line.

Three poverty measures are used to estimate seasonal poverty for Rangpur and the rest of Bangladesh. The official poverty estimates, referred to here as *moderate poverty*, are based on the cost-of-basic-needs method. To apply this method, one must establish expenditure to estimate the poverty line. The definition of moderate poverty is based on this official poverty line, which includes the cost of a minimum food basket—also called the food poverty line—and an allowance for nonfood expenditures. *Extreme poverty*, by contrast, is defined by a household's total consumption expenditure on food and nonfood falling short of the food poverty line. Finally, *food* *poverty* is defined as a situation in which a household's food expenditure falls short of the food poverty line.

The official poverty-line estimates are disaggregated to reflect rural and urban price variations across regions.[10] For all three survey years (2000, 2005, and 2010), 2000 prices are used to estimate poverty lines and consumption expenditures. Because we use these same price deflators, all monetary figures in this study related to the HIES for these years are at 2000 prices.

Figures 9-10 show the seasonal variations in estimated poverty.[11] Poverty generally peaks toward the pre-aman period during survey years 2000 and 2005. By contrast, in 2010, seasonal poverty peaks during the boro season, rather than the pre-aman season, which is new and certainly a deviation from 2000 and 2005. The leveling off of seasonal poverty during the 2010 pre-aman period is observed for all regions of the country. However, Rangpur, unlike the rest of the country, experiences pronounced seasonal poverty that persists beyond the traditional monga period. The higher incidence of poverty in this region for all seasons can be clearly seen; yet official poverty statistics do not recognize this reality (BBS 2011).

3.5 Employment

Seasonality of poverty and income may be influenced by pronounced seasonality of wages and employment. We argue that the main source of seasonality concerns the lack of employment and income-earning opportunities during the monga season, and not so much the seasonality of agricultural wages. The seasonal distribution of employment among poor households in Rangpur is estimated using a 2008 InM survey of households (which is a follow-up of a baseline survey carried out in 2006). The estimated monthly days worked in farm and nonfarm sectors by season are averages for the entire sample of households, although the employment patterns obviously

[10] Food prices are derived from household-level information on quantity and expenditure, and nonfood price deflators are based on official cost-of-living indexes.

[11] We report extreme and food poverty only. However, the trend in moderate poverty (not reported here) is very similar to that in the two other measures of poverty.

differ by occupational group within those households. Nevertheless, the results are quite revealing (Figure 11). The major source of employment seasonality is the strikingly large decline in farm wage employment during the monga season.

Rangpur's comparative disadvantage is also evident from trends in monthly agricultural wage rates in real terms (Figure 12). While these wage rates have shown an upward trend for the country overall, they have consistently lagged in Rangpur, demonstrating that lack of real wage and employment growth is a prime factor in the persistence of year-round and seasonal poverty.

4. Does income seasonality affect consumption and poverty?

Given that income seasonality in Bangladesh is more pronounced in Rangpur than in other regions, it is important to determine whether income seasonality affects the seasonality of consumption and poverty. Using 2000 and 2005 HIES data, Khandker (2012) applied the standard consumption-smoothing model used to estimate the effect of income seasonality on consumption to estimate the effect of income seasonality on poverty. This study extended the analysis to 2010 HIES data to determine whether the earlier findings still hold.

We consider that consumption C_{ijs} (the per capita consumption expenditure of household i in village j in season s) would depend on total per capita annual income (Y), as well as its seasonal shares (y), along with such other variables as prices, preferences, and local area characteristics (e.g., Deaton 1997; Kazianga and Udry 2006; Khandker 2012; Paxson 1993). We then consider the following consumption equation in semi-logarithmic form, for which seasonal consumption, among other variables, is determined by per capita annual income (Y) and its seasonal shares (y):

$$\ln C_{ijs} = \alpha\tau_s + \beta_1 \ln Y_{ij} + \beta_2 y_{ijs} + \gamma X_{ij} + \mu_{ij} + \mu_{sj} + \eta_j + \varepsilon_{ijs}, \qquad (1)$$

where X_{ijs} is a vector of household- and village-level characteristics, including prices, influencing consumption and income; τ_s is a dummy variable representing the seasons; α, β, and γ are unknown parameters to be estimated; and ε_{ijs} is a zero-mean disturbance term representing the unmeasured determinants of C_{ijs} that vary across households. It should be noted that household consumption is affected by unobserved household- and village-level heterogeneity represented by the error terms μ_{ij} and η_j, respectively, as well as unobserved season-specific heterogeneity (μ_{sj}).

One should note that β_1 measures the response of seasonal consumption and poverty to total income, while β_2 measures the response to seasonal income. Thus, if $\beta_2 = 0$, seasonality is not an issue, and seasonal income does not track seasonal consumption and poverty, perhaps because a household has the ability to smooth consumption through self-insurance and other means to compensate for losses in income, if any, during a particular season; that is, seasonal consumption depends entirely on year-long, rather than seasonal, income. This case illustrates a perfect consumption-smoothing model.

The estimation of equation (1) is problematic because both income and consumption may be jointly affected by unobserved factors, such as household and village heterogeneity represented by the error terms μ and η, respectively. There is substantial evidence for joint dependence of income and consumption (Strauss 1986; Strauss and Thomas 1995). More specifically, it is likely that measurement errors in consumption and income are correlated, which may seriously bias the estimated coefficients (Deaton 1997; Ravallion and Chaudhuri 1997).

To circumvent this issue, we use the instrumental variable (IV) method to estimate the income variables, both total annual income (*Y*) and seasonal income. The IVs used relate to aspects of the production environment, such as community infrastructure (e.g., the presence of banks, microcredit programs, and safety net programs) and agroclimate characteristics (e.g., land elevation, average number of sunny months, share of flood-prone areas, and amount of excess rain per month). Local wage rates are also included among the IVs, based on the assumption that they influence only income and not consumption directly.[12]

[12] Here we rely on the assumption of a perfect substitutability model of income and consumption with an active labor market to justify the instrumental variable method (Singh, Squire, and Strauss 1986).

The focus of this analysis is to estimate a consumption or poverty model to demonstrate the extent of the net effect of income seasonality on consumption and poverty. To do this, we need to introduce a model with common seasonal effects using seasonal panel data (i.e., repeated observations across seasons for more than one year). For this model, we use the combined data of the three rounds of the HIES (2000, 2005, and 2010), which provide a cross-section of households and villages surveyed across seasons over the three years. Because the upazila is the lowest common sampling unit for the HIES data, we can create the panel at this level and estimate an upazila-level fixed-effects (FE) regression model.[13] Thus, this model can control for upazila-specific unobserved seasonal bias (μ_{sj}).[14]

We divide the country into two regions (greater Rangpur and the rest of Bangladesh) and consider two seasons (monga and non-monga).[15] Because of data limitations, seasonal crop income is used to reflect income seasonality. Taking into account the seasonal variations in crop income, seasonal income share (y) is thus expressed as the ratio of monthly seasonal income to monthly year-round income.

The estimated coefficients of the consumption equation (1) showing the effects of overall and seasonal income are presented in Table 2. The consumption equation was estimated separately for food consumption and total consumption. The results confirm that crop income seasonality does affect the seasonality of consumption. As expected, per capita seasonal consumption (estimated on a monthly basis) is strongly related to per capita year-round income (also estimated

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[13] The term upazila refers to a subdistrict consisting of 10–12 unions, which again consist of 10–12 villages. In the 2005 and 2010 HIES surveys, some upazilas were newly selected and thus could not be matched with the 2000 survey data. Merging data at the upazila level over the three survey years results in a common set of 164 upazilas included in the upazila-level panel.

[14] The ideal panel can be formed only at the household level, with the same households interviewed in different seasons over the three survey years. To apply the upazila-level FE method, we first multiply an upazila dummy with a seasonal dummy to create an upazila-level seasonal dummy. Because we have two seasons (i.e., monga and non-monga), the difference between these upazila-seasonal dummies cancels out the seasonal-specific unobserved effect within an upazila (μ_{sj}). Because these upazila-seasonal dummies are also observed in three years, the difference between them in the three years cancels out upazila-specific fixed effects (η_j). Details are provided in Khandker (2012).

[15] As mentioned previously, Bangladesh has four distinct agricultural seasons, but here the three non-monga seasons are collapsed into one.

as the monthly average). For example, a 10 percent increase in per capita annual income increases per capita seasonal food consumption by 6.2 percent and total per capita consumption by 7.6 percent.

More significant for this analysis, the seasonal variation in income (represented by the ratio of monthly income in a season to year-round monthly income) is found to be a significant determinant of seasonal food and total consumption. If, for example, this ratio increases from 1 (suggesting no income seasonality) to 2 (suggesting a doubling of the income in that season) in a season, the estimated coefficients suggest that seasonal food consumption will increase by 41.6 percent and total seasonal consumption by 39.2 percent.[16] That increase implies a very strong relation between seasonal income and seasonal consumption, including food consumption.

The statistically significant coefficient of the year dummy in Table 2 indicates that seasonal food consumption grew autonomously by 31.9 percent in real terms between 2000 and 2005 and by more than 54 percent in real terms between 2000 and 2010. The coefficient of the interaction between the Rangpur dummy and the year dummy suggests that this increase was higher for Rangpur compared to the rest of the country for seasonal food consumption, though not for seasonal total consumption.[17]

Comparing these findings with those of Khandker (2012) we see that, while the contribution of total income in consumption has increased in the longer term, that of income seasonality has decreased. Also, monga season has now an independent impact on consumption, unlike what was found in Khandker (2012). Finally, consumption growth over the longer term seems higher than it has been in the shorter term.

[16] This particular interpretation of the value of the estimated coefficients of the income seasonality variable is derived from the semilogarithmic form of the equation in which the value of the coefficient represents the proportionate change in the dependent variable with respect to a unitary change in the explanatory variable.
[17] The inclusion of a dummy for the monga season and another for the interaction of the monga dummy with a Rangpur dummy yielded no statistically significant regression coefficients. This suggests that there were no statistically significant effects of any income seasonality other than what was captured by the seasonality of crop income either for the entire country or for Rangpur specifically; details on these exercises are provided in Khandker (2012).

Overall, the evidence suggests that changes in seasonal consumption track seasonal income, indicating that households are unable to smooth consumption with crop income across seasons. This finding contradicts the null hypothesis of perfect consumption smoothing and is consistent with findings from other countries (e.g., Kazianga and Udry 2006; Jalan and Ravallion 1999).[18]

However, the analysis thus far has not tackled the question of whether income seasonality affects poverty itself. If lack of consumption smoothing is a major hurdle for many households, particularly among the poor, it is expected that income seasonality would also affect the incidence of poverty. To estimate the effect of seasonality on poverty, we simulate the poverty effects using the estimates of the consumption equation (1), as presented in Table 3.

As Table 3 shows, the poverty effects predicted using the consumption estimates clearly confirm the negative effect of income seasonality on all measures of seasonal poverty. This means a decrease in seasonal income in relation to year-round income will increase seasonal poverty, and vice versa. This is true for all three types of poverty (i.e., moderate, extreme, and food). For example, an increase of 10 percentage points in the ratio of seasonal monthly income to year-round monthly income will decrease seasonal food poverty by 0.43 percentage points, extreme poverty by 0.32 percentage points, and moderate poverty by 0.31 percentage points. However, with respect to a 10 percent increase in year-round monthly income, the estimates of seasonal poverty reduction are 0.64 percentage points for both extreme and moderate poverty and 0.62 percentage points for food poverty. Thus, seasonal income has a strong effect on seasonal poverty, even though year-round income is also an important determinant. And lack of consumption smoothing that leads to seasonal poverty is caused more by idiosyncratic factors than an aggregate shock. These findings are very similar to those of Khandker (2012). While the contribution of total income is about the same in both studies the role of seasonal income in poverty is less pronounced now, albeit statistically significant.

[18] This finding contradicts those of Paxson (1993) for Thailand and Jacoby and Skoufias (1998) for India.

5. What are the mitigating policies for seasonal hunger?

The analyses of the underlying causes of seasonal deprivation in northwest Bangladesh point to some policy failures. Given that seasonal poverty adversely interacts with chronic poverty and represents an aggregate shock to which certain households are more vulnerable than others owing to idiosyncratic factors, the mitigating policies and programs must be both broad-based and well-targeted. Examples of appropriate broad-based programs include infrastructure development programs to help promote income diversification and overall income growth, while such targeted programs as Food for Work (FFW) and other types of public food distribution or cash transfers can focus on vulnerable households, particularly during the lean (monga) season. Moreover, microcredit and other targeted policies to create income-earning opportunities for the poor can also help mitigate poverty over the long term.

Because seasonal hunger is determined by the interactions of the economic and agroecological factors that characterize a rural economy, it is important to understand how certain regions, such as Rangpur, differ in their ability to access public policies and programs. It has been observed that households in Rangpur, unlike those in the rest of the country, have less access to nonfarm sources of income, including remittances. Households in Rangpur are also disadvantaged by poorer access to formal credit, electricity, and other infrastructure facilities (Khandker and Mahmud 2012). But the placement of programs is not random; rather, it is influenced by agroclimate and other local area endowments, which also affect the economic opportunities in a given locality (e.g., subdistrict [upazila] or village). Certain types of public programs, such as road investments, may target the better-endowed upazilas or villages since they may seek areas with better terrain and higher economic potential. Conversely, other types of public programs, such as social safety nets for the poor, may target poorly endowed areas. With cross-sectional data, it is difficult to estimate the effects of policies and programs net of the effects caused by the underlying unobserved area characteristics (Binswanger, Khandker, and Rosenzweig 1993).

To counter the bias due to the joint determination of program placement, poverty, and seasonality by the observed and unobserved agroclimate and ecological factors, we use the upazila-level seasonal panel data from the 2000 and 2010 HIES to apply an FE regression model. Household outcome variables are estimated using such household characteristics as human and physical capital endowments, along with access to public policies and programs as explanatory variables, but excluding time-invariant agroclimate area characteristics. This approach is equivalent to running a reduced-form equation in which income, consumption, or poverty is expressed as a function of all price and nonprice exogenous policy variables, such as public infrastructure and credit-related investments (Khandker 2009).

The regression results of consumption, income, and poverty showing the effect of public policies and programs are presented in Table 4. The income and consumption equations are estimated in semi-logarithmic form (i.e., income and consumption are in log form), whereas poverty estimates are simulated using the consumption estimates against the respective poverty thresholds of consumption. The results relating to the effects of household characteristics (e.g., education of household head or ownership of land and other assets), though important, are not reported here because they are not of primary interest for this analysis. Overall, the results are fairly robust in terms of both statistical significance of the estimates and the implied effect of policy interventions.

The results indicate a strong positive effect of human capital investments on household welfare. Each additional year of education for the head of household can be seen to increase total per capita income by 2.5 percent and total per capita consumption by 2.3 percent, thus reducing moderate poverty (by 1.8 percentage points), extreme poverty (by 1.2 percentage points), and food poverty (by 1.1 percentage point). Moreover, although per capita income is increased, its seasonality is reduced, presumably because education helps income diversification.

The results shown in Table 4 also suggest that a lack of human and physical capital is a major source of both structural and seasonal poverty. Between land and nonland assets, the latter have stronger positive effects on consumption and negative effects on poverty. For example, a one percent increase in the size of a landholding reduces extreme poverty by 3.1 percentage points, whereas a similar increase in nonland assets reduces extreme poverty by 9.8 percentage points. Nonland assets also help reduce income seasonality. Therefore, a policy that stipulates asset transfers to the poor as a way to mitigate monga is likely to have more beneficial effects if it focuses on transfer of assets other than land. This outcome should also be true for microcredit and other such programs that encourage asset accumulation by the poor.

Electrification has the expected substantial positive effects on income and consumption and thus negative effects on poverty, especially seasonal food deprivation. Households living in villages with electricity are likely to have their per capita total consumption increased by 6.8 percent, and moderate poverty reduced by 5.8 percentage points, extreme poverty by 5.7 percentage points, and food poverty by 5.3 percentage points. Electricity connection provides opportunities for expanding both farm and nonfarm income, ultimately helping to increase consumption and thus reduce poverty and seasonal food deprivation.[19]

Apparently, the presence of commercial banks has no significant effect on consumption and poverty; however, presence of an agricultural bank branch in the village has significant poverty reduction effects. Similarly, microcredit programs such as the Grameen Bank are found to increase food consumption by 2.4 percent and thus reduce food poverty (by 2.0 percentage points), moderate poverty (by 1.9 percentage points), and extreme poverty (by 1.8 percentage points).[20]

Social safety net programs, including FFW and Vulnerable Group Feeding (VGF), contribute substantially to overall per capita total consumption and food consumption, resulting in the reduction of all forms of poverty.[21]

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[19] The provision of irrigated land in the village is found not to enhance food consumption. Public investment in rural roads may help to mitigate poverty; however the HIES does not include rural roads data.

[20] Since these changes occur over a five-year period, an annual reduction in moderate poverty due to a microcredit program such as Grameen Bank was equivalent to about half of a percentage point.

[21] The VGF program, administered by the government, provides food to a select number of households in a community affected by disasters or during a period when acquiring food is difficult for beneficiary households. Priority is given to households that are low income, lack agricultural land or other productive

To determine whether certain programs have a particularly beneficial effect on consumption and poverty during the lean (monga) season, we obtained regression results using a monga dummy that interacts with program variables, such as the Grameen Bank, FFW, and VGF. The results, not shown here, support that access to the Grameen Bank and FFW during the monga season contributes substantially to both food expenditure and total consumption per capita. Thus, the Grameen Bank presence in a village increases food consumption by 5.2 percent and total consumption by 7.3 percent during the monga season. On the other hand, the FFW operation increases food and total consumption by 3.8 percent and 4.8 percent, respectively, clearly demonstrating the consumption-smoothing role of these targeted programs, which is valid for all regions of the country, including Rangpur.

6. Conclusion and policy implications

This study, following on an earlier study on the seasonality of Bangladesh (Khandker 2012), adds value in two ways. First, it allows us to examine whether the findings from the earlier study still hold for a longer timeframe, in particular, what are the factors that affect seasonality, whether income seasonality leads to consumption seasonality, how policy interventions matter, and so on. Second, this study also allows us to examine the trend in various outcomes and underlying factors. With two time points we can observe change but cannot really establish trends, which require at least three time points.

Seasonality of income, consumption, and poverty is a common feature of rural Bangladesh; yet it is more marked in the Rangpur region where the interlocking of seasonality and endemic poverty results in severe seasonal hunger. The persistent phenomenon of seasonal hunger in Rangpur is explained by the region's adverse economic geography and agroecological

assets, including day laborers, or are headed by women. In a normal year, a distressed household receives two-to-three months of food rations, with no work or labor participation required.

vulnerability, which are reflected in the pattern of employment and income-earning opportunities of poor households.

An analysis of Bangladesh's reality of seasonal hunger vis-à-vis year-round poverty shows a clear disparity between what is observed and what is in the official statistics of poverty and its regional distribution. The Rangpur region has not only lagged other regions in poverty reduction; it has also remained particularly vulnerable to seasonal hunger or monga.

The severe and persistent seasonal hunger observed in Rangpur can only occur as the result of the confluence of many adverse factors, which generally reflect the region's agroecological vulnerability and adverse economic geography. Thus, it is not so much a lack of food availability that causes monga; rather, it is not having enough income-earning opportunities at a particular time of the year in a region with poor agroclimate endowments. Hence, poverty reduction through integrating the labor and credit market is likely to help reduce the adverse effects of seasonality.

Evidence suggests that seasonal food consumption is related to seasonal income at least as strongly as it is to year-round income. Seasonal poverty and hunger can thus be seen to result from the marked seasonality in agricultural income, combined with the lack of poor households' capacity to smooth consumption, such as through savings, loans, or food storage. Combating seasonal hunger thus calls for reducing income seasonality through agricultural and rural income diversification and enhancing the ability of poor households to insure against seasonality.

Poor households' inability to smooth consumption in the face of income seasonality raises both policy-related and behavioral issues. Rural households use traditional risk management devices, such as pooling of local resources or mutual support provided by family or friends. While such community-based insurance is feasible when risks are idiosyncratic (i.e., particular to a few households), it has limited use in the event of aggregate shocks, such as seasonal ones. The unpredictability of the extent of seasonal stress may also explain inadequate self-insurance by poor households, either through savings or storage of grains. But even in the case of a predictable decline in income, it is difficult for poor households living at or near subsistence level to consciously fend off future hardship. That is, immediate needs may compromise poor households' ability to smooth consumption. Therefore, the persistent nature of endemic poverty cannot be properly understood without taking into account the seasonal dimension of poverty.

Bangladesh has a fairly large and elaborate social safety net system aimed at safeguarding the economic security of the poor and vulnerable groups. These programs can potentially act as a type of social insurance against seasonal poverty, but their effect may be limited because of inappropriate targeting, resource leakages, and limited coverage dictated by funding constraints.

Therefore, it is important to identify a set of policies and programs that can effectively address the interlocking problems of poverty, food insecurity, and seasonality. More important, these policies must be well-coordinated and perhaps require a three-pronged approach: (i) combining seasonally-oriented policies with those that aim at removing the underlying structural causes of endemic poverty, (ii) reducing income seasonality through agricultural and rural diversification and enhancing the ability of poor households to insure against seasonality, and (iii) helping poor households cope with seasonal hunger so they can avoid taking extreme coping measures under distress.

In sum, there is no single cure for seasonal hunger. Bangladesh may need to implement an array of specific measures with the help of government agencies, NGOs, and international actors. Ultimately, the challenge is how to enhance the ability of the rural poor to cope with the increasing complexity and uncertainty linked to seasonality by making their livelihoods more flexible, adaptable, and resilient.

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Tables

Table 1. Summary statistics of income, expenditure, and poverty measure by division

Outcome indicator	Barisal	Chittagong	Dhaka	Khulna	Rajshahi	Sylhet	Rangpur
			2000				
Income	1,057.2	932.3	847.4	1,001.4	802.0	917.0	617.3
(Tk./capita/month)	(5,507.6)	(1,731.8)	(896.5)	(1,629.6)	(553.7)	(1,532.3)	(780.3)
Expenditure	723.6	801.7	715.8	746.3	676.9	820.7	590.0
(Tk./capita/month)	(429.8)	(486.2)	(503.8)	(408.9)	(315.1)	(527.4)	(379.6)
Moderate poverty (%)	42.9	47.1	54.2	56.7	64.9	58.2	70.9
	(49.5)	(49.9)	(49.8)	(49.6)	(47.8)	(49.4)	(45.5)
Food poverty (%)	48.7	55.7	61.5	66.0	71.8	66.2	79.3
	(50.0)	(49.7)	(48.7)	(47.4)	(45.0)	(47.4)	(40.5)
Extreme poverty (%)	32.1	26.9	43.8	41.7	50.9	32.4	60.9
	(46.7)	(44.3)	(49.6)	(49.4)	(50.0)	(46.9)	(48.9)
			2005				
Income	787.8	993.3	917.0	977.2	982.5	1,056.0	717.0
(Tk./capita/month)	(719.2)	(1,664.0)	(1,010.4)	(1,064.4)	(829.5)	(1,262.3)	(609.9)
Expenditure	795.5	899.2	1,022.1	1,021.2	823.9	992.2	730.8
(Tk./capita/month)	(619.1)	(606.7)	(813.1)	(1,189.6)	(497.6)	(1,502.3)	(424.1)
Moderate poverty (%)	54.1	36.0	34.9	33.2	46.5	38.4	56.0
	(49.9)	(48.0)	(47.7)	(47.1)	(49.9)	(48.7)	(49.7)
Food poverty (%)	54.8	34.7	41.1	48.3	55.3	40.0	57.9
	(49.8)	(47.6)	(49.2)	(50.0)	(49.7)	(49.1)	(49.4)
Extreme poverty (%)	37.4	19.4	23.3	21.4	30.1	23.1	41.9
	(48.4)	(39.5)	(42.3)	(41.1)	(45.9)	(42.2)	(49.4)
			2010				
Income	1,094.5	1,451.5	1,291.5	1,482.5	1,214.3	1,181.3	950.3
(Tk./capita/month)	(1,455.6)	(2,157.8)	(2,170.6)	(6,590.1)	(1,456.2)	(2,192.7)	(941.4)
Expenditure	1,166.0	1,405.8	1,147.5	1,237.0	1,249.5	1,146.8	968.1
(Tk./capita/month)	(1,092,5)	(1,127.2)	(685.6)	(817.6)	(860.7)	(1,022.3)	(584.7)
Moderate poverty (%)	37.2	27.5	36.2	28.8	30.6	28.5	47.9
	(48.4)	(44.6)	(48.1)	(45.3)	(46.1)	(45.2)	(50.0)
Food poverty (%)	38.2	27.8	36.6	33.4	36.9	29.2	42.4
	(48.6)	(44.8)	(48.2)	(47.2)	(48.3)	(45.5)	(49.5)
Extreme poverty (%)	25.4	14.2	21.1	14.9	16.7	23.0	32.4
	(43.6)	(34.9)	(40.8)	(35.6)	(37.3)	(42.1)	(46.8)

Source: Authors' calculation based on HIES data, 2000, 2005, and 2010.
Note: Figures in parentheses are standard deviations. Monetary figures are CPI-adjusted (2000=100).

Table 2. Evidence of income and consumption seasonality in Bangladesh (Determinants of consumption using instrumental variables (IVs) with thana-level FE

Selected explanatory variable	Log per capita total consumption (Tk./month)	Log per capita food consumption (Tk./month)
Year = 2005	0.269	0.319
	(7.37)	(9.71)
Year = 2010	0.469	0.543
	(6.02)	(7.75)
Log per capita total income (Tk./month)	0.757	0.619
	(19.81)	(17.52)
Ratio of monthly seasonal income to monthly average income	0.392 (2.40)	0.416 (2.91)
Ratio of monthly seasonal income to monthly average incomeXRangpur region	0.647 (0.98)	0.691 (1.18)
Pre-aman season	0.064	0.054
	(1.97)	(1.90)
Pre-aman season, Rangpur region	0.104	0.166
	(0.67)	(1.20)
Rangpur region, year = 2005	0.005	0.160
	(0.08)	(2.83)
Rangpur region, year = 2010	0.023	0.202
	(0.40)	(3.69)
F-statistics for the model	$F(29, 10747) = 142.69$, $p = 0.000$	$F(29, 310747) = 98.22$, $p = 0.000$
χ^2 statistics from endogeneity test	$\chi^2(3) = 305.23$, $p = 0.000$	$\chi^2(9) = 282.77$, $p = 0.000$
N	10,940	10,940

Source: Authors' calculation based on HIES data, 2000, 2005, and 2010.
Note: The Rangpur region differs from the Rangpur division. For the estimation, data from the 2000, 2005, and 2010 HIES rounds are combined and then households from only those thanas common to all three rounds are kept. Income variables are treated as endogenous and thus instrumented. Instrumental variables (IV) are community infrastructure (e.g., presence of banks, NGOs, and safety net programs) and agroclimate characteristics (e.g., land elevation, average number of sunny months, and number of rainy months). Regressions include other household-level (e.g., head's sex, age, and education and land and non-land assets) and community-level (e.g., prices of consumer goods and daily wage) variables. Figures in parentheses are t-statistics based on robust standard errors.

Table 3. Predicted poverty effects of income using consumption estimates reported in Table 2

Income variable	Moderate poverty	Food poverty	Extreme poverty
Log per capita total income (Tk./month)	-0.064	-0.062	-0.064
	(-19.81)	(-17.52)	(-19.81)
Ratio of monthly seasonal income to monthly average income	-0.031	-0.043	-0.032
	(-2.40)	(-2.91)	(-2.40)

Source: Authors' calculation based on HIES data, 2000, 2005, and 2010.
Note: In this exercise, the poverty effects are calculated as follows. The regression coefficient of log per capita total income is multiplied by the per capita expenditure (total or food) to get the estimated change in the level of per capita expenditure due to income change. The change in per capita expenditure is then subtracted from the actual per capita expenditure to get what would have been the per capita expenditure if changes in annual or seasonal income had not occurred. This per capita expenditure is then used to calculate corresponding poverty measures. The changes in these measures and the actual poverty are the (simulated) poverty effects, which are reported here. Figures in parentheses are t-statistics from the corresponding consumption regression.

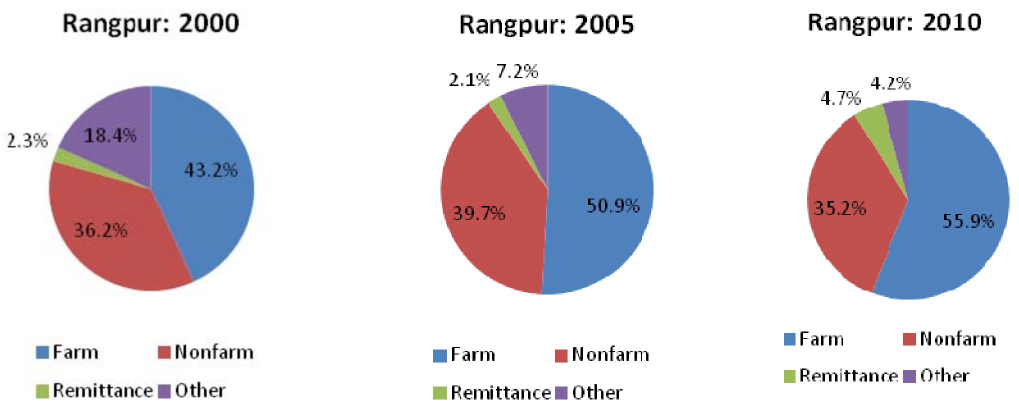
Table 4. Thana-level FE estimates of policy and program placements on income, expenditure, and poverty

Explanatory variable	Per capita income (Tk./month)	Per capita consumption (Tk./month)	Simulated effects on seasonal poverty using consumption estimates		
			Moderate poverty	Food poverty	Extreme poverty
Head's education (years)	0.025 (14.13)	0.023 (22.59)	-0.018 (-22.59)	-0.011 (-11.55)	-0.012 (-22.59)
Log of land asset (decimal)	0.034 (7.69)	0.038 (15.42)	-0.031 (-15.42)	-0.029 (-12.37)	-0.031 (-15.42)
Log of non-land asset (Tk.)†	0.174 (29.95)	0.111 (33.69)	-0.099 (-33.69)	-0.070 (-23.91)	-0.098 (-33.69)
Village has electricity	0.054 (2.75)	0.068 (6.14)	-0.058 (-6.14)	-0.053 (-5.28)	-0.057 (-6.14)
Proportion of irrigated land in village	-0.066 (-1.42)	-0.018 (-0.93)	0.017 (0.93)	0.004 (0.25)	0.015 (0.93)
Village has any agricultural bank (1 = yes, 0 = no)	0.020 (0.80)	0.023 (1.64)	-0.019 (-1.64)	-0.027 (-1.94)	-0.018 (-1.64)
Village has any commercial bank (1 = yes, 0 = no)	-0.012 (-0.47)	0.012 (0.86)	-0.008 (-0.86)	-0.008 (-0.62)	-0.008 (-0.86)
Village has Grameen Bank (1 = yes, 0 = no)†	0.020 (0.90)	0.024 (1.88)	-0.019 (-1.88)	-0.020 (-1.80)	-0.018 (-1.88)
Village has FFW program (1 = yes, 0 = no)†	0.036 (1.98)	0.032 (3.08)	-0.025 (-3.08)	-0.053 (-3.44)	-0.025 (-3.08)
Village has VGF program (1 = yes, 0 = no)†	0.040 (2.23)	0.047 (4.61)	-0.038 (-4.61)	-0.057 (-5.67)	-0.039 (-4.61)
R^2	0.215	0.421	-	-	-
Joint significance of policy variables marked by †	X^2 (4) =701.76, $p > \chi^2 = 0.000$	χ^2 (4) = 387.99, $p > \chi^2 = 0.000$			
N	10,940	10,940	10,940	10,940	10,940

Source: Authors' calculation based on HIES data, 2000, 2005, and 2010.
Note: For the estimation, data from the 2000, 2005, and 2010 HIES rounds are combined and then households from only those thanas common to all three rounds are kept. Figures in parentheses are t-statistics; for the income and expenditure regressions, they are based on robust standard errors and for the poverty regressions, they are from the corresponding consumption regressions. Regressions additionally include community prices of consumer goods, daily wage, and agroclimate characteristics (land elevation, average number of sunny months, share of flood-prone area, and excess rain amount per month). Poverty effects are calculated in the same way as noted in Table 3.

Figures

a) Rangpur



b) Rest of Bangladesh

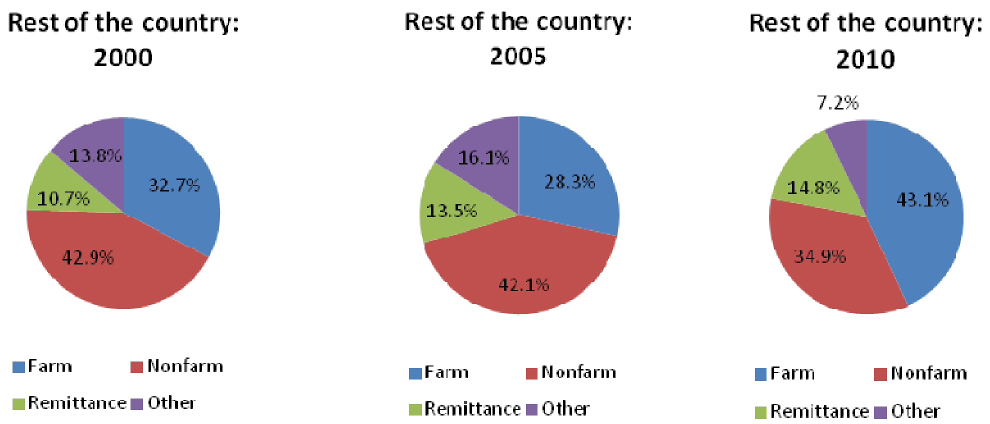


Figure 1. Change in income composition over time by region, 2000–10

Source: Authors' calculation based on HIES data, 2000, 2005, and 2010.

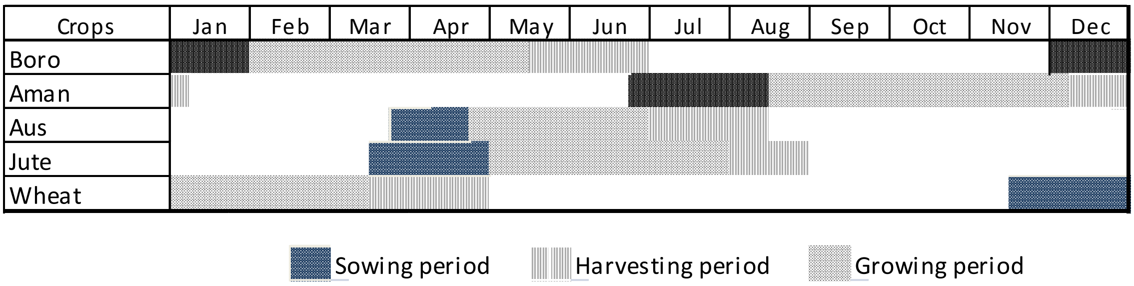


Figure 2. Crop calendar for major crops in Bangladesh

Source: Estimated from data reported in the Statistical Year Book of Bangladesh (various years), Bangladesh Bureau of Statistics.

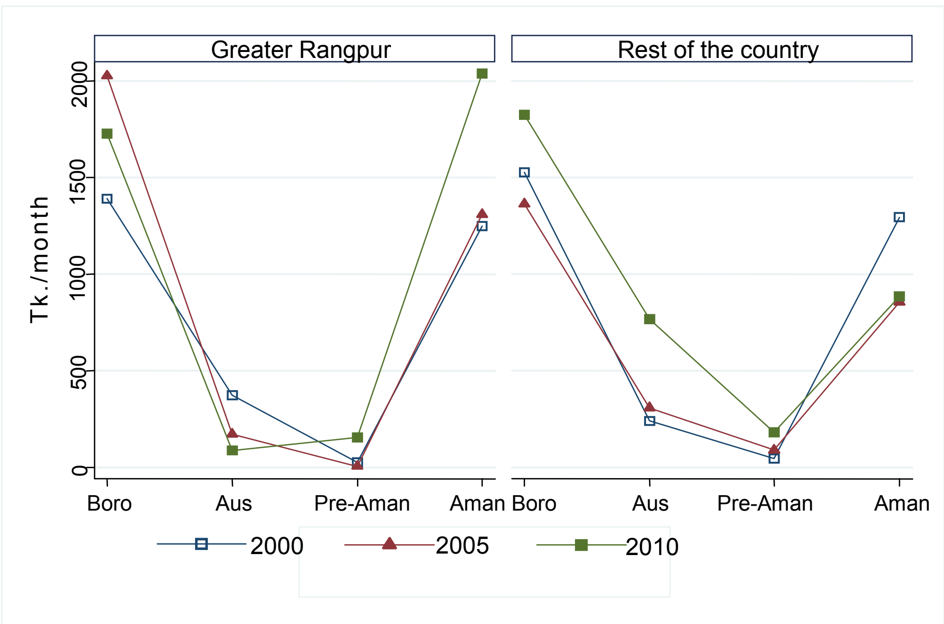


Figure 3. Household crop income by season

Source: Authors' calculation based on HIES data, 2000, 2005, and 2010.
Note: Monetary figures are CPI-adjusted (2000=100).

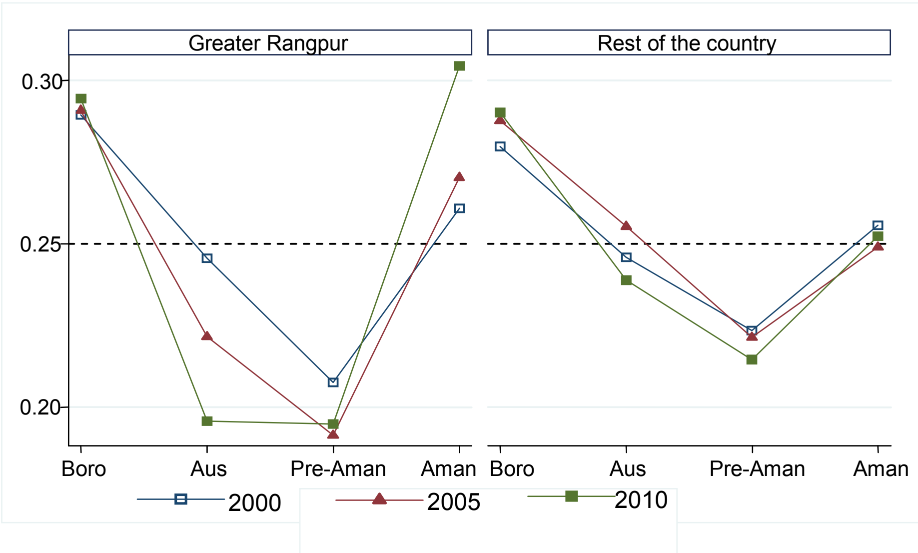


Figure 4. Share of household income by season

Source: Authors' calculation based on HIES data, 2000, 2005, and 2010.

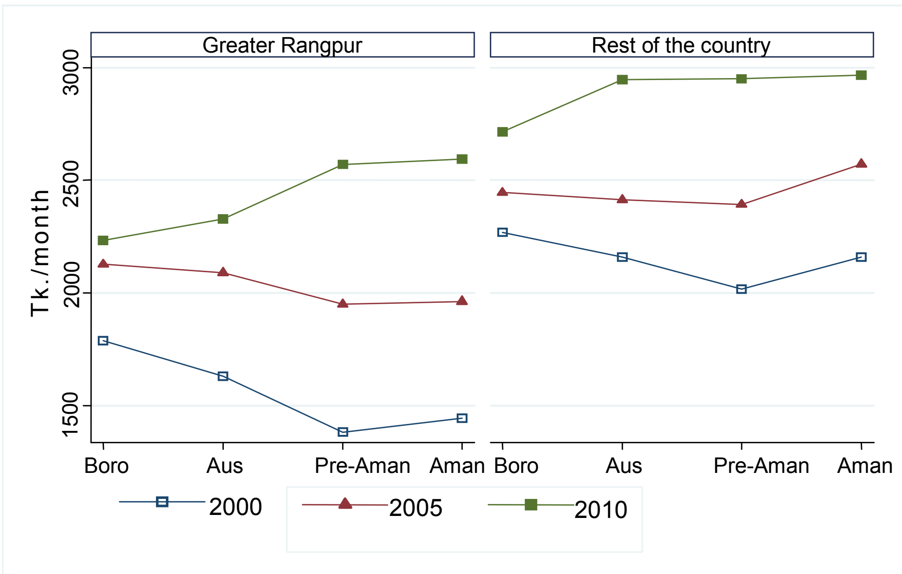


Figure 5. Household monthly food expenditure by season

Source: Authors' calculation based on HIES data, 2000, 2005, and 2010.
Note: Monetary figures are CPI-adjusted (2000=100).

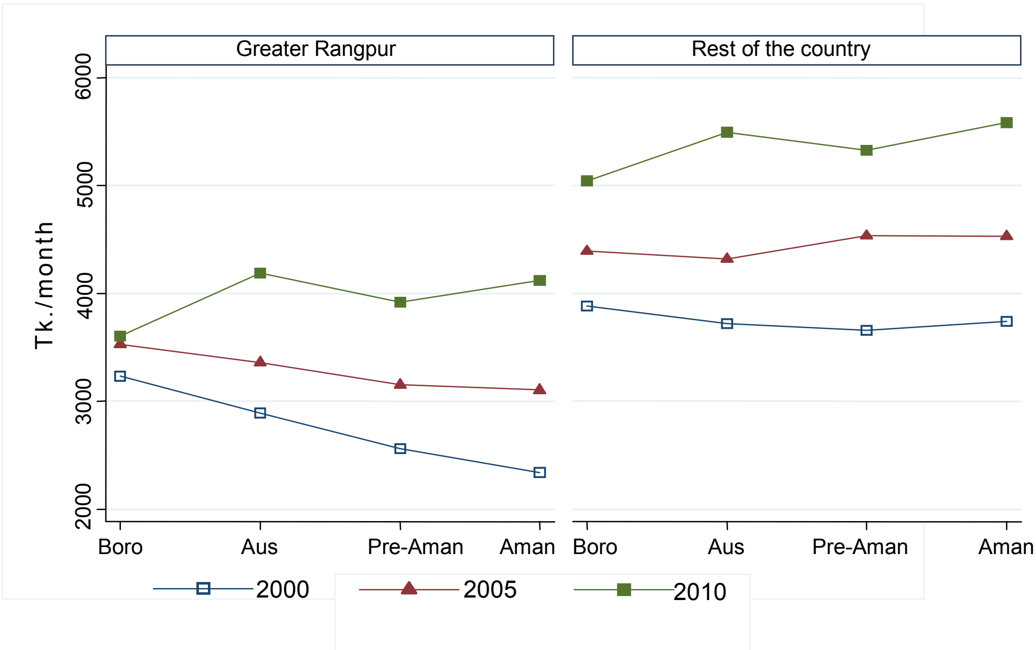


Figure 6. Household monthly total expenditure by season

Source: Authors' calculation based on HIES data, 2000, 2005, and 2010.
Note: Monetary figures are CPI-adjusted (2000=100).

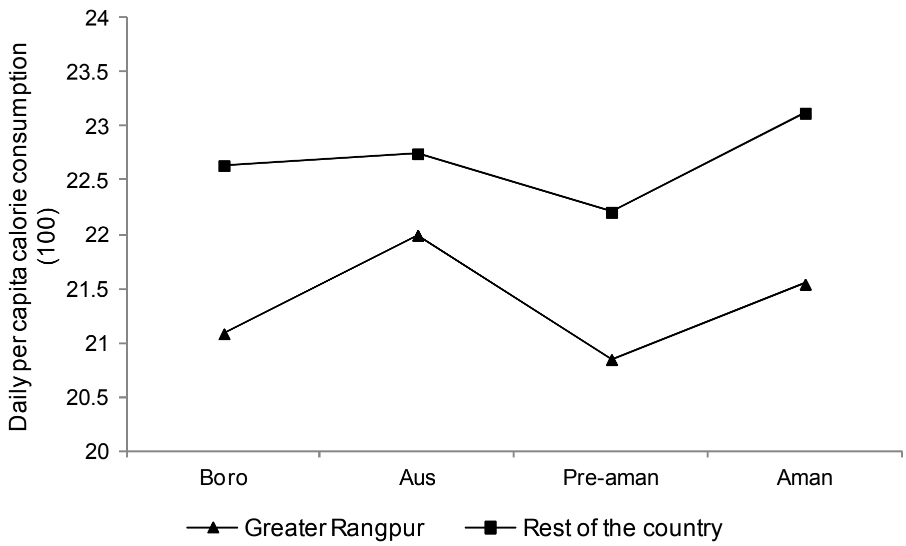


Figure 7. Seasonal pattern of caloric intake by region, 2005

Source: Khandker (2012).

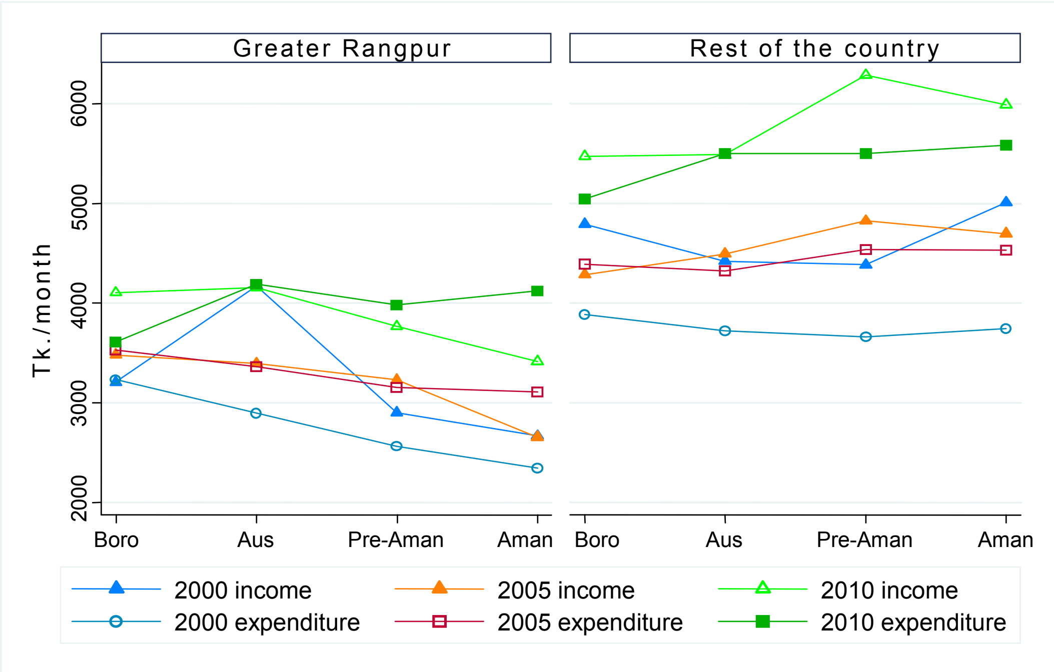


Figure 8. Change in income and expenditure by season over time, 2000–10

Source: Authors' calculation based on HIES data, 2000, 2005, and 2010.
Note: Monetary figures are CPI-adjusted (2000=100).

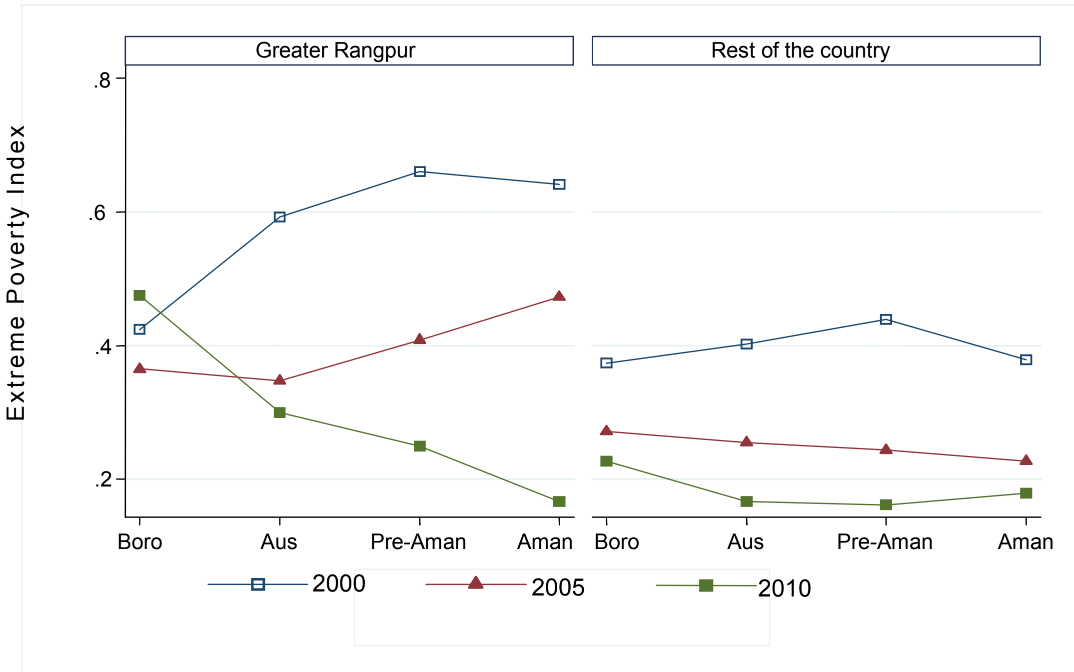


Figure 9. Change in extreme poverty by season over time, 2000–10

Source: Authors' calculation based on HIES data, 2000, 2005, and 2010.

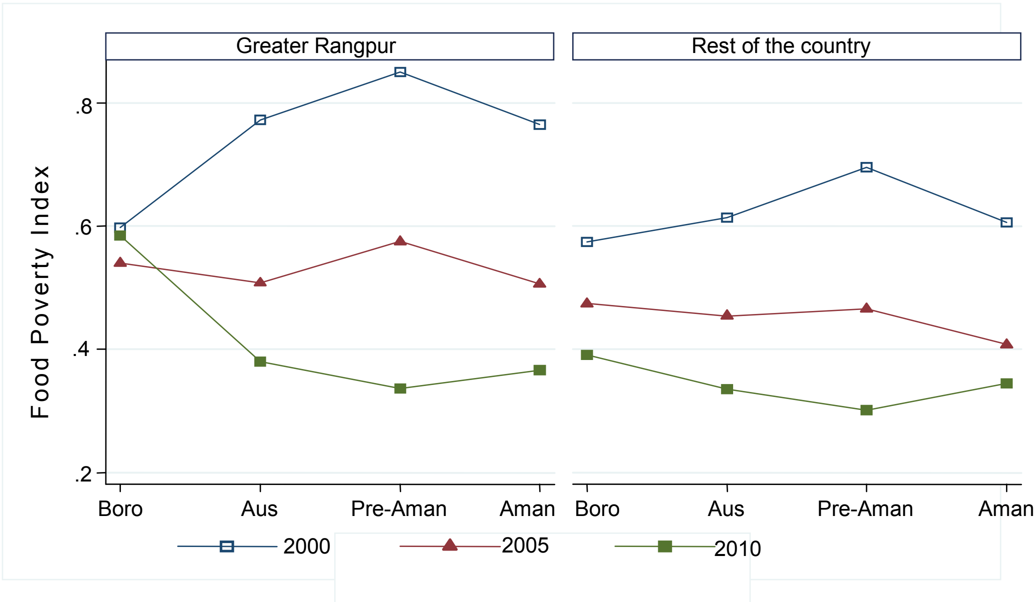


Figure 10. Change in food poverty by season over time, 2000–10

Source: Authors' calculation based on HIES data, 2000, 2005, and 2010.

Figure 11. Seasonal employment pattern for poor households in Rangpur by sector, 2008

Source: Authors' calculation based on InM follow-up survey (2008).

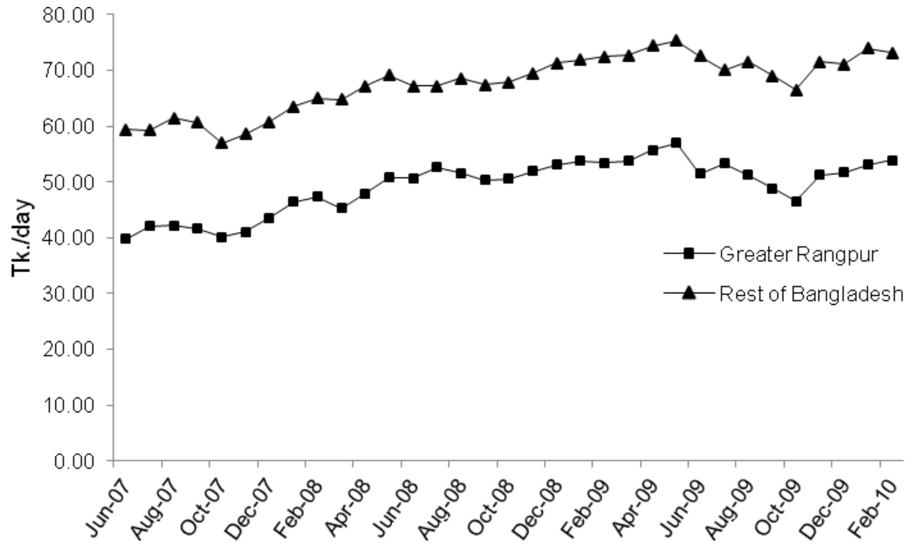


Figure 12. Monthly trend in agricultural wage rates of males (without meals), 2007–10

Source: Khandker and Mahmud (2012).
Note: Figures are deflated by monthly rural consumer price index (1995–96 = 100). Trends are similar for female agricultural laborers, although women's wages are significantly lower than men's across all regions.

Abstract (in Japanese)

要約

バングラデシュ北西部に位置するラングプールは、その自然環境、農耕条件、および経済地理的な制約により、バングラデシュの中でも特に所得や消費、貧困の季節変動が深刻な地域である。本論文では、2000 年、2005 年、2010 年の 3 期間にわたって実施された家計調査のパネルデータを使用し、Khandker （2012）の結果を再検証し、貧困の季節性の決定要因と対処方法について考察している。

本論文では、次の 2 つの視点から再検証を行った。第一に、Khandker(2012)の結果が、より長い期間においても引き続き観測されるかどうかという点である。第二に、3 期間のパネルを使うことで、貧困の季節性のトレンドとその決定要因を分析することである。その結果、北西バングラデシュにおける季節的飢餓（monga）は、通年の所得合計およびその季節変動によって引き起こされていることが明らかとなった。

本論文では、この地域特有の貧困と農業生産の季節性の悪影響を緩和するためには、労働、食糧及び信用市場の構造的な統合が必要であることを提言している。即ち、季節的飢餓に対処するためには、農業や農村所得の多様化を図るとともに、貧困家計が所得の季節性に備える能力を高めることが重要である。