

Working Paper No. 4

Vulnerability to Seasonal Hunger and its Mitigation in Northwest Bangladesh

Shahidur R. Khandker

M. A. Baqui Khalily

Hussain A. Samad

April 2010



Institute of Microfinance (InM)

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Shahidur R. Khandker*

M. A. Baqui Khalily*

Hussain A. Samad*

*Dr. Shahidur R. Khandker is a Lead Economist at the World Bank. Dr. M. A. Baqui Khalily is a Professor of Finance at the University of Dhaka, and Mr. Hussain A. Samad is a Consultant at the World Bank.

Abstract

Seasonal hunger is a form of deprivation in Bangladesh, especially in greater Rangpur. For policymaking purpose, knowing who are going to be in seasonal hunger in future is more important than knowing who already are. Our analysis shows that both *ex post* and *ex ante* measures of seasonal deprivation are common for the extreme poor and that seasonal deprivation is thus more of a structural than seasonal phenomenon.

An econometric analysis, however, suggests that seasonal income explains, to some extent, the incidence of seasonal deprivation. But physical and human capital endowments of poor households matter a lot to explain who are likely to be vulnerable to seasonal deprivation. More importantly, policies affect both the intensity of seasonal deprivation and its vulnerability. Investments in electrification and irrigation are found to create long-term income earning opportunities, thereby reducing seasonality of hunger. Likewise better access to micro-credit and safety net programs provide opportunities to the extreme poor to stave off seasonal hunger.

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1. Introduction

The objective of this paper is to determine the extent of seasonal hunger and its vulnerability among rural households in Bangladesh, especially in the Northwest part of Bangladesh (i.e., the greater Rangpur region) and examine policy options in mitigating them.¹ Seasonal hunger, also known as *monga* in greater Rangpur, is caused by a deprivation of food during certain months of the year when households do not have adequate employment, income, and savings. That is, *monga* is an *ex post* measure of seasonal deprivation of food. However, for policymaking purpose, knowing who are going to be in seasonal hunger in future is more important than knowing who already are. This *ex ante* measure of seasonal food deprivation can be defined as vulnerability. That is, vulnerability to seasonal hunger is the likelihood of remaining in or falling into seasonal hunger in future. Households smooth consumption via income smoothing and other measures, which also reduce their vulnerability to *monga*. When consumption smoothing does not happen for one reason or another, food deprivation is sure to follow.

The Northwest part of Bangladesh (i.e., the greater Rangpur region) experiences seasonal food deprivation almost every year during mid-September to mid-November, which corresponds to a period between post-planting and pre-harvesting of *aman* rice and known as *monga* period.² This is the lean period for labor demand when the impact of scarcity of jobs on household welfare is very pronounced. According to Sen (1981), this is a period when the ability of a large segment of the population is limited in acquiring food, employment and other basic necessities.

Among the various measures that households adopt to stave off the adverse effects of *monga*, distress sale of assets (such as land), and advance sale of labor and crop are quite common. In addition, they resort to migration and some have access to social safety net programs. But these measures may not be enough. As a result, they may starve for an extended period, which may lead to serious malnutrition and death in extreme circumstances. The intensity of *monga* varies by households and local socio-economic conditions; it also depends on the incidence of flood or drought that often precedes pre-*aman* period. Households' vulnerability to *monga* is also a failure of public policies and programs that cannot help mitigate poverty in general and *monga* in particular.

There is a large body of literature on seasonality and consumption smoothing. Household incomes vary by season, often quite sharply. For example, Chaudhuri and Paxson (2001) finds from the ICRISAT sample of Indian villages that agricultural households on an average receive 75 percent of their annual income in just a three-month period. Like income, household consumption levels also vary by season in rural economies (e.g., Sahn 1989; Paxson 1993; Dercon and Krishnan 2000). It is frequently asserted that the observed seasonality in consumption is driven largely by the seasonal variation in income, and partly by the lack of proper credit markets. However, consumption seasonality may also be due to

¹ Greater Rangpur area consists of five districts: Gaibandha, Kurigram, Lalmonirhat, Nilphamari, and Sadar Rangpur.

² We will use the word *monga* in multiple ways throughout this paper. First, *monga* means seasonal deprivation in general. Second, *monga* period defines the pre-harvesting of *aman* period from mid-September to mid-November. And lastly, *monga* region refers to Northwest region of Bangladesh (that is, greater Rangpur area).

non-credit factors, such as seasonal variation in prices, preferences, labor efforts and precautionary savings motives (Chaudhuri and Paxson 2001). For instance, Paxson's (1993) findings suggest that in rural Thailand the observed seasonality in consumption patterns results from variation in prices or preferences (which are common to all households) more than from households' inability to use savings or borrowings to smooth consumption.

Yet lack of credit could potentially be an important determinant in seasonal consumption, especially for very poor rural economies (Townsend 1995). There is evidence that credit constraints prevent poor households from smoothing consumption across years (Rosenzweig 1988; Rosenzweig and Wolpin 1993; Chaudhuri and Paxson 2001). Pitt and Khandker (2002) shows that micro-credit provision helps smooth consumption by offering an effective means to diversify agricultural income and employment.

Findings from the literature suggest a few lessons for policymaking. First, it is important to examine the extent and sources of seasonality among rural households of whole Bangladesh vis-à-vis greater Rangpur. The purpose is to examine why *monga* has been persistent in Rangpur as compared to other regions. Second, it is important to ascertain whether seasonality is amenable to policies. For example, if it is driven by price fluctuations, the goal of policy could be to stabilize prices. On the other hand, if seasonality is being driven largely by credit constraints, there is a clear need for more credit.

Another important aspect worth examining is to look at how households, especially the poor, cope with *monga* and what mechanisms they adopt to smooth consumption and avoid food deprivation during the lean season. It is important to examine how efficient these mechanisms are, and whether there is any role for formal credit provision. Alternatives to formal credit could be costlier from a household efficiency standpoint and susceptible to failing completely in the event of an aggregate shock (Townsend 1995).

The objective of this paper is four-fold: (1) examine whether household welfare has improved over time in greater Rangpur vis-à-vis other regions using a variety of household welfare measures including poverty and vulnerability; (2) test whether seasonality of income affects the incidence of seasonal deprivation; (3) investigate what policies have helped reduce poverty and vulnerability if any; and (4) find out what specific policies (credit, asset transfer or social safety net programs) matter most in mitigating incidence and vulnerability to seasonal deprivation.

The paper uses household income and expenditure surveys (HIES) of 2000 and 2005 carried out by the Bangladesh Bureau of Statistics (BBS) to address the above four issues. The paper also utilizes a recent (2006) data set collected by the Institute of Microfinance (InM). The HIES surveys are representative of entire rural population of Bangladesh. The InM survey, in contrast, was limited to the hard-core poor among rural households of greater Rangpur. The HIES data contain detailed questionnaires about living conditions, while the InM data contain limited information about household welfare with a focus on the extent and scope of seasonal hunger and deprivation. This survey was carried out as part of an effort of the *Palli Karma Shahayak Foundation* (PKSF) to identify the most *monga*-vulnerable households and to design and implement appropriate interventions to mitigate *monga*. The InM survey was carried out right after the *monga* of 2006 (where *monga* period refers to the months of mid-September to mid-November).

The paper is organized as follows. Section two discusses the stylized facts about Rangpur vis-à-vis other regions using HIES and InM data with a particular focus on the *monga* conditions. Section three introduces alternative indicators of household welfare and insecurity in terms of both objective and subjective measures of seasonal hunger and

vulnerability. One of the findings is that vulnerability to *monga* is highly structural and that vulnerable households are extremely poor. Section four estimates a structural model of poverty and vulnerability, where welfare is expressed in terms of some socioeconomic factor, conditional on income seasonality. The objective is to determine the role of income seasonality in seasonal poverty and vulnerability. Section five examines a reduced-form approach to determine the ultimate factors that can help households mitigate poverty and vulnerability, both *ex post* and *ex ante*. Finally, the last section concludes the paper with policy implications.

2. Household Welfare and Seasonal Hunger: What Do We Know?

An analysis of HIES survey data shows that rural households gained both economically and socially over the years, although disproportionately across the regions. For example, people in greater Rangpur are worse off than those in rest of the country in several economic outcomes, such as income (both earned and non-earned), expenditure, and poverty level. (Table 1, and Figures 1 and 2). For example, in 2005, non-earned income explains only about 11 percent of household income in Rangpur, while it is 32 percent in the rest of the country. Since, non-farm sources constitute about same share of total income in both regions (roughly 40 percent), households in greater Rangpur depend much more on agriculture (almost 50 percent) than those in other areas (27 percent). Of particular importance is the share of agricultural wage, income, which is more in Rangpur (15 percent) than in the rest of the country (8 percent). This was not surprising given the fact that the daily real wage

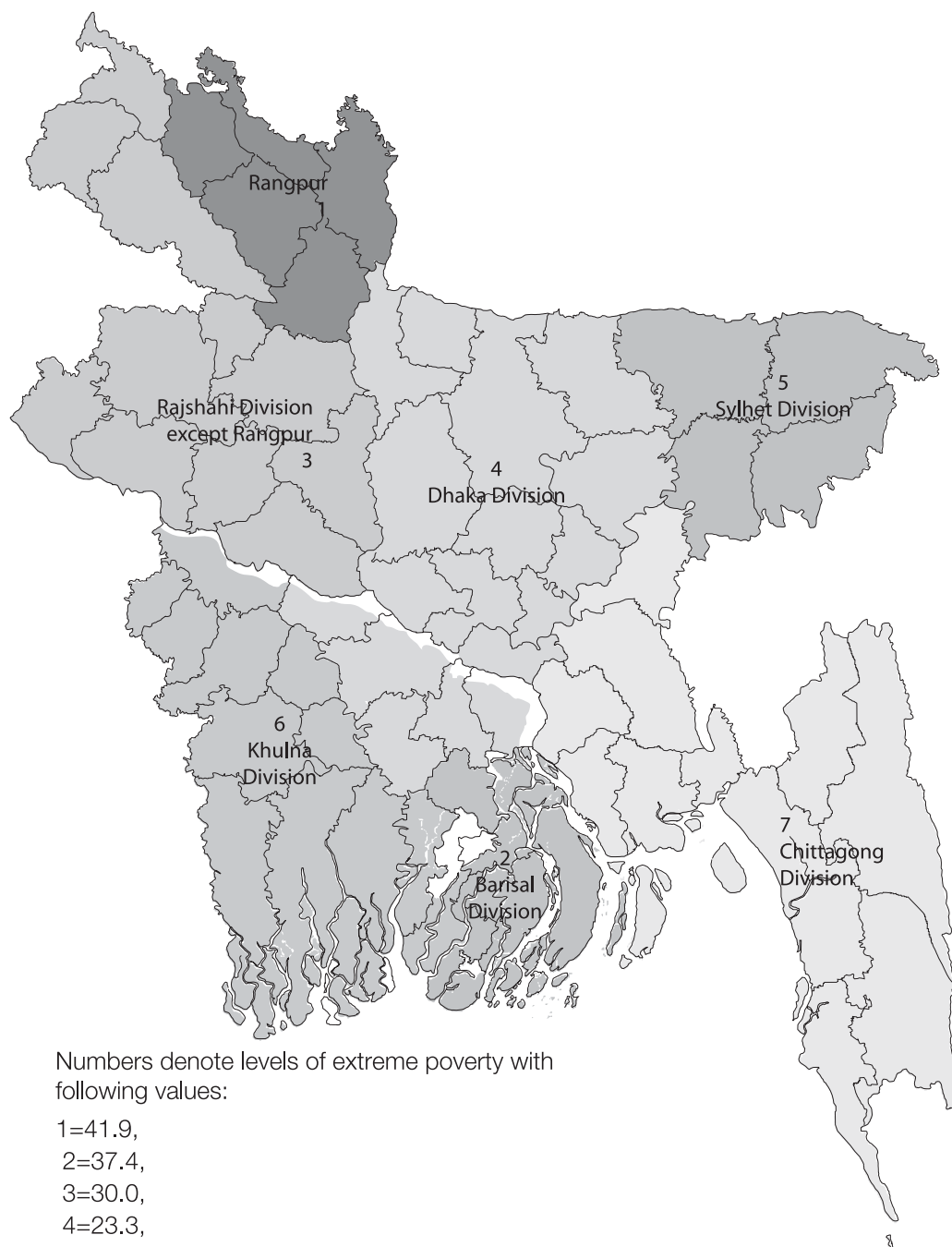
Table 1: Selected welfare indicators of rural households

Indicators	Greater Rangpur		Rest of the country		Wholesample	
	2000	2005	2000	2005	2000	2005
Per capita total income (Tk./month)	616.3	648.3	902.2	927.3	876.1	900.8
Per capita earned income (Tk./month)	486.0	576.4	666.3	632.8	649.9	627.4
Per capita non-earned income (Tk./month)	130.3	72.0	235.8	294.5	226.2	273.4
Per capita receipt from remittance (Tk./month)	17.9 (13.7)	17.1 (23.7)	106.7 (45.4)	132.6 (45.4)	98.6 (39.3)	121.7 (41.5)
Per capita receipt from safety net programs (Tk./month)	1.8 (1.4)	2.0 (2.7)	2.4 (1.0)	3.3 (1.1)	2.3 (1.2)	3.2 (1.3)
Per capita total expenditure (Tk./month)	570.5	661.0	782.2	914.2	762.9	890.2
Access to electricity (%)	6.6	17.9	19.9	31.2	18.7	30.0
Land asset (decimal)	82.0	123.7	84.3	152.6	84.1	149.9
Access to formal credit (%)	6.4	7.1	9.6	9.3	9.3	9.1
Observations	440	520	4,600	5,520	5,040	6,040

Note: Earned incomes are receipts from active employment. Non-earned incomes are receipts from investments, assets, pensions, remittances, gifts/charities and safety net programs. Safety net programs are VGD, VGF, IFS, FFW (money), Test Relief, GR, Money for Education, RMP, Old Age Pension, Freedom Fighters Pension, etc. Figures in parentheses are share (%) of non-earned income. Monetary figures are CPI adjusted with base year 2000.

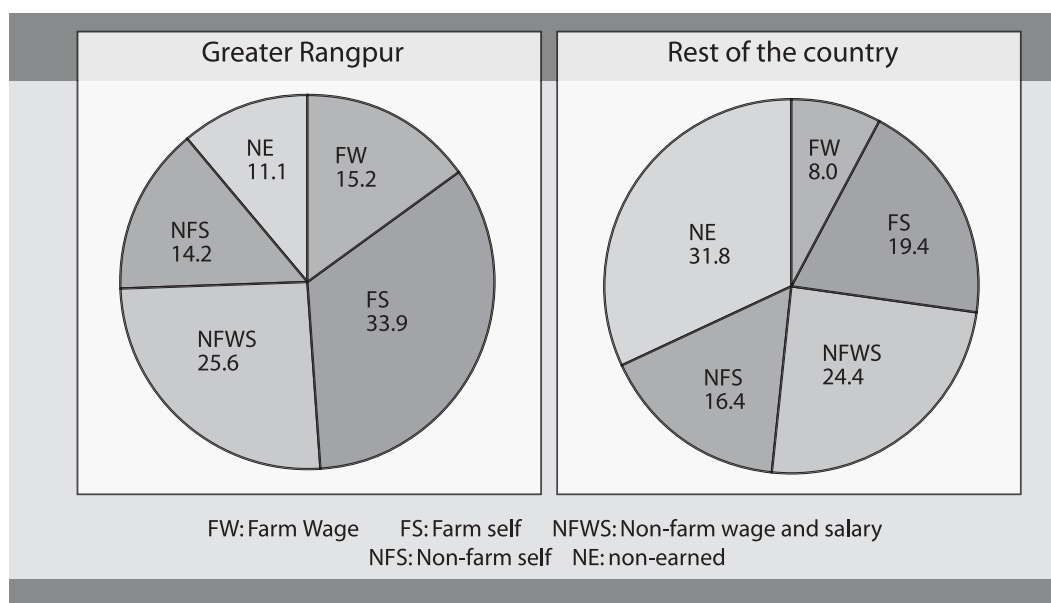
Sources: HIES surveys, 2002 and 2005.

Figure 1
Bangladesh: Regional disparity at a glance



Source: HIES survey 2005

Figure 2: Breakdown of household income by source in 2005 (%)



Source: HIES survey 2005.

Table 2: Summary statistics of selected household characteristics by district in greater Rangpur

HH characteristics	Kurigram	Gaibandha	Nilphamari	Lalmonirhat	Rangpur	All districts
Dependency ratio*	0.65 (0.19)	0.64 (0.21)	0.63 (0.21)	0.63 (0.21)	0.57 (0.24)	0.63 (0.21)
HH land (decimals)	8.80 (12.47)	8.21 (12.73)	9.71 (14.51)	6.65 (10.31)	6.25 (10.72)	8.20 (12.59)
HH has agricultural asset	0.30 (0.46)	0.59 (0.49)	0.55 (0.50)	0.49 (0.50)	0.56 (0.50)	0.49 (0.50)
HH has nonagricultural asset	0.16 (0.36)	0.11 (0.32)	0.13 (0.34)	0.11 (0.31)	0.13 (0.33)	0.13 (0.34)
HH has savings	0.43 (0.49)	0.34 (0.47)	0.28 (0.45)	0.26 (0.44)	0.32 (0.47)	0.34 (0.47)
HH has cow	0.29 (0.45)	0.27 (0.45)	0.30 (0.46)	0.19 (0.39)	0.21 (0.40)	0.26 (0.44)
HH head is self-employed	0.21 (0.21)	0.15 (0.36)	0 (0)	0.30 (0.46)	0.20 (0.40)	0.16 (0.37)
HH head is wage employed	0.44 (0.50)	0.65 (0.48)	0.73 (0.44)	0.57 (0.49)	0.23 (0.42)	0.54 (0.50)
Observations	120,426	128,987	102,866	56,772	71,867	480,918

*Note: Dependency ratio is the proportion of dependents in household. Excluded category of the self- and wage-employed includes the following: beggars and unemployed.

Source: InM survey 2006.

rate for male agricultural worker in Rangpur is much less (Tk. 46) than that in the rest of country (Tk. 64).³

Households in greater Rangpur region also get very little in remittance (23.7 percent of non-earned income), compared to those in rest of the country (45.4 percent of non-earned income) in 2005 (Table 1). Households in Rangpur are worse off in other aspects too—their access to electricity and formal credit are less than that of their counterparts in other areas. However, as expected, households in Rangpur get more from safety net programs than those in other parts of the country, implying more dependence of the poor households in Rangpur on such programs.

Table 2 presents from the InM data a summary of key welfare indicators for the extreme poor in greater Rangpur. These households are characterized by high dependency ratio (0.63), high wage employment rate (54 percent) and low self-employment rate (16 percent).⁴ Since the poor are mostly wage employed in agriculture, they are likely to suffer from low wage income growth experienced in the Northwest region. This table also shows that 13 percent of the poor have non-agricultural asset, and about 49 percent have some type of agricultural asset. However, the poor possess only 8.2 decimals of land, making them virtually landless. Finally, these characteristics do not vary much across the five districts of greater Rangpur.

The hardcore or extreme poor in the InM survey was defined on the basis of income and assets, not consumption.⁵ HIES survey data provides consumption data and therefore can be used to measure consumption-based poverty, including hardcore or extreme poverty. We thus define from HIES data three measures of consumption-based poverty and compare them between Rangpur and other regions. A household is considered moderately poor if per total capita expenditure (food and nonfood) is less than the total poverty line established for the region (as defined in Table 3). Similarly, a household is considered food-poor if its per capita food consumption is less than the food poverty line established for the region (Table 3).⁶ Extreme or hardcore poverty, on the other hand, is usually characterized by a situation when a household, with combined food and nonfood expenditure, cannot match the food poverty line, let alone the total poverty line. So, extreme poverty indicates a dire economic situation worse than food poverty.

Table 3: Poverty lines by region

Poverty line (Tk./month)	Greater Rangpur		Rest of the country		Whole sample	
	2000	2005	2000	2005	2000	2005
Total poverty line	582.0	766.5	654.9	826.1	648.3	820.4
Food poverty line	509.6	655.9	551.9	706.3	548.1	701.5
Observations	440	520	4,600	5,520	5,520	6,040

Sources: HIES surveys, 2002 and 2005.

³ These are 2005 figures from HIES data.

⁴ Dependency ratio is measured by the proportion of dependent (that is, non-working) members among all members.

⁵ In InM survey, hardcore poor are those households who satisfy at least one of the following criteria: having less than 50 decimals of land, having a monthly income of Tk.1500 or less, or selling labor for daily wage. Hardcore or extreme poor constitutes of 45 percent of the total households in greater Rangpur. This is not very different from the findings of HIES survey of 2005, which shows that some 42 percent of rural households were extreme or hardcore poor in greater Rangpur (Table 4).

⁶ Food poverty line is calculated by estimating the cost of a food basket needed to maintain the per capita daily caloric requirement (2112 calories) recommended by FAO (Food and Agricultural Organization). Since, HIES data refers to food consumption during the month preceding the survey interviews and household interviews were conducted uniformly over a whole year period, food consumption and calculated food poverty reflect seasonal figures corresponding to the time of interviews.

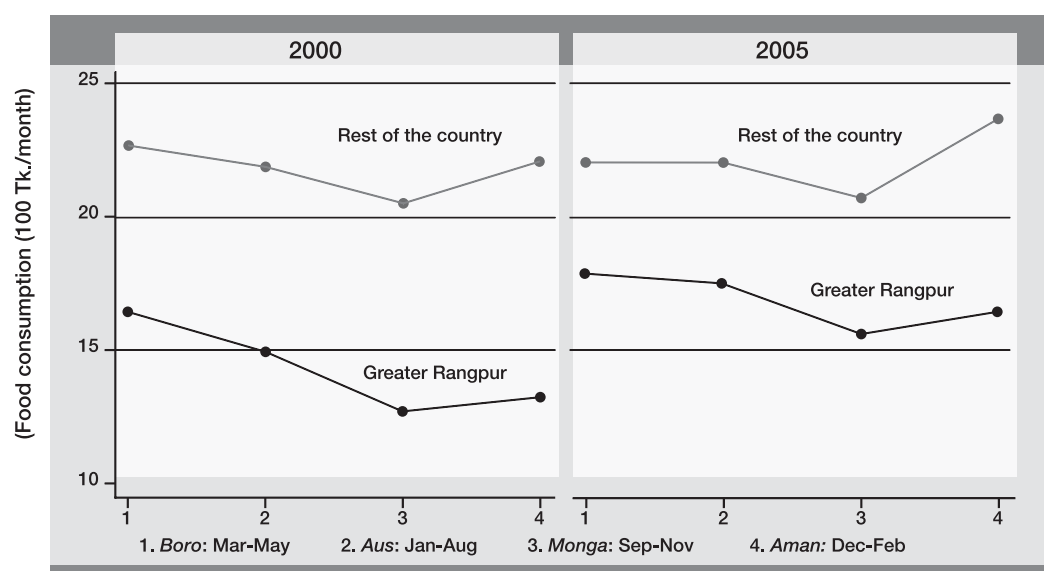
Table 4: Insecurity measures of rural households in Bangladesh

Insecurity measures	Greater Rangpur		Rest of the country		Wholesample	
	2000	2005	2000	2005	2000	2005
Moderate poverty headcount (%)	67.0	56.0	49.5	39.2	51.1	40.8
Extreme poverty headcount (%)	55.7	41.9	33.7	24.9	35.7	26.5
Vulnerability to poverty (%)	67.7	64.8	50.5	47.0	52.1	48.7
Observations	440	520	4,600	5,520	5,040	6,040

Sources: HIES surveys, 2002 and 2005.

As Table 4 shows, Bangladesh's impressive performance in poverty reduction is not uniform across the country. Although overall poverty has declined, the incidence of poverty is higher in the lagging regions of greater Rangpur. While the overall rural poverty rate was 40.8 percent in 2005, greater Rangpur had a rural poverty rate of 56 percent in 2005. Extreme poverty in Rangpur region was also higher (41.9 percent in 2005) than the national rural average (26.5 percent). Both types of poverty reduced between the survey years in both regions. Table 4 also reports households' vulnerability to poverty, which will be discussed in next section.

As the paper's focus is on seasonal hunger and poverty, let us consider the seasonal dimensions of food consumption. This is to determine if rural households face pronounced seasonality in consumption of food and whether seasonality is more pronounced in Rangpur than the rest of the country. In HIES surveys, households across the country were interviewed uniformly throughout the year. So, as mentioned before, the consumption data, among other information, reflect seasonal variation in food

Figure 3: Food consumption by season

Source: HIES surveys, 2000 and 2005.

consumption.⁷ According to the distinct seasonal cycle of agricultural production, we group the consumption information by four distinct seasons, expressed in terms of the harvest period of three main crops in Bangladesh - *boro* (March-May), *aus* (June-August), pre-harvest *aman* which is the *monga* period (September-November), and *aman* (December-February).

Figure 3 presents food consumption for rural households based on the HIES of 2000 and 2005. In both years, the overall food consumption per capita is much lower in Rangpur than in the rest of the country. The seasonality in food consumption is also more pronounced in Rangpur than in other regions. The food consumption falls sharply during the pre-harvest *aman* period (i.e., *monga* period) in both regions. This clearly indicates a severe shortfall in food, resulting in subsequent starvation from the seasonality in agriculture. Another important identifiable feature is that the ability of rural households to recover from the consumption decline during *monga* period is better in the rest of the country than in Rangpur, particularly in 2005. Among these issues, the sharp decline in consumption during the lean season must be a major concern for the poor in greater Rangpur.

Such seasonality of food consumption together with extreme poverty in greater Rangpur is very likely to lead to severe food deprivation, evidence of which we find from the InM survey data. The InM data have three types of food intake status for the hardcore poor surveyed in greater Rangpur: occasional starvation (households were forced to go without meals for a day or more), food rationing (households were forced to consume less than what they normally would have in a day) and full meals (households had consumed desired quantity of meals, which is usually 3 meals a day). This information was recorded for both *monga* and non-*monga* periods for the same households.

Table 5 shows that a high percentage of the rural poor in greater Rangpur experience a high rate of seasonal starvation during the *monga* season of 2006. Some 41 percent of poor households managed to have full meals during non-*monga* season, while only 4 percent had full meals during *monga* season. Also some 50 percent rationed meal in both seasons, indicating a desperate form of food insecurity among the hardcore poor in greater Rangpur. More strikingly, only 8.5 percent households experienced occasional starvation during non-*monga* season, compared to 47 percent during the lean season, demonstrating a dire

Table 5: Distribution of HHs their meal consumption status (%)

Consumption status	Kurigram	Gaibandha	Nilphamari	Lalmonirhat	Rangpur	All districts
Non-Monga period						
Occasional starvation	2.08 (14.27)	12.18 (32.71)	2.32 (15.05)	14.36 (35.07)	17.10 (37.65)	8.53 (27.94)
Food rationing	49.36 (50.00)	63.44 (48.16)	32.89 (46.98)	54.78 (49.77)	53.33 (49.89)	50.85 (50.00)
Consumption of full meals	48.56 (49.98)	24.38 (42.94)	64.79 (47.76)	30.86 (46.19)	29.57 (45.64)	40.62 (49.11)

⁷ The question may arise whether poverty figures represent any role of seasonal dimension. Note that although consumption aggregates, the basis for poverty calculation, include both food and non-food, more than 80 percent of total expenses comprise of food expenses. The information on food expenses is drawn from seasonal consumption data, while the non-food expenses are drawn from yearly data. To the extent that the non-food expenses do not vary much across seasons, the poverty (either moderate or extreme) data displays seasonality which is primarily driven by seasonality in food consumption.

Consumption status	Kurigram	Gaibandha	Nilphamari	Lalmonirhat	Rangpur	All districts
<i>Monga period</i>						
Occasional starvation	48.47 (49.98)	57.62 (49.42)	26.16 (43.95)	47.95 (49.96)	56.34 (49.60)	47.27 (49.93)
Food rationing	50.14 (50.00)	40.79 (49.14)	60.37 (48.91)	49.54 (50.00)	40.35 (49.06)	48.29 (49.97)
Consumption of full meals	1.39 (11.70)	1.59 (12.52)	13.47 (34.14)	2.51 (15.64)	3.31 (17.89)	4.44 (20.61)
Observations	120,426	128,987	102,866	56,772	71,867	480,918

Note: Figures in parenthese are standard deviations.

Sources: InM survey 2006

situation of seasonal hunger among the very poor in greater Rangpur. Combining occasional starvation with food rationing, we can say that more than 95 percent of the extreme poor in greater Rangpur experienced some form of seasonal food insecurity during the lean period.

3. Defining Vulnerability to Poverty and Seasonal Deprivation

The welfare insecurity measures presented in section 2 are *ex post* measures of household well-being, which are snapshots of a particular period of time. For policymaking, it is more important to know who is likely to be poor or have food insecurity in the future, which is an *ex ante* measure. Vulnerability often refers to such *ex ante* measure (Pritchett, Suryahadi, and Sumarto 2000; Chaudhuri 2003; Chaudhuri, Jalan and Suryahadi 2002). In this section, we formulate such a measure of vulnerability using household data on consumption or food deprivation.

Vulnerability of a household is intuitively defined by the future probability of its having a shortfall of per capita consumption from the poverty line. In practice, this probability is given by the cumulative distribution function of such shortfall, normalized by the variance of the error term of the consumption equation. More formally, if c_{it} represents the consumption level of household i during time t against the poverty line z_{it} , its vulnerability is given by,

$$V_{it} = \Pr[c_{it} < z_{it}] = \Pr[\ln(c_{it}) < \ln(z_{it})], \quad (3.1)$$

and index of such vulnerability is given by,

$$\hat{v}_{it} = \Pr\left[\xi_{it} < \frac{\ln(z_{it}) - X_{it}\hat{\beta}}{\sqrt{X_{it}\hat{\theta}}}\right] = \phi_{it}\left[\frac{\ln(z_{it}) - X_{it}\hat{\beta}}{\sqrt{X_{it}\hat{\theta}}}\right] \quad (3.2)$$

where X is a vector of household and community characteristics used in consumption equation, $\hat{\beta}$ is an estimate of the vector of parameters influencing consumption, $\hat{\theta}$ is the estimate of the variance of the error term of consumption equation, $\phi_{it}(\cdot)$ is the cumulative

normal distribution function, and ξ_{it} is given by,

$$\xi_{it} = \frac{\ln(c_{it}) - X_{it}\hat{\beta}}{\sqrt{X_{it}\hat{\theta}}}$$

Here we assume that $\ln(c_{it})$ is normally distributed in a large sample with a mean of $X_{it}\hat{\beta}$ and a variance of $X_{it}\hat{\theta}$. Further details of this formulation can be found in Chaudhuri (2003) and Khandker (2006).

Using the HIES data, we can calculate vulnerability index of a household based on equation (3.2), which gives its probability of being poor in future based on its current characteristics.⁸ The index varies from 0 to 1, where 0 indicates non-vulnerability and 1 refers to maximum vulnerability. From this broad spectrum of probabilities we need to identify households that can be called vulnerable, because such identification is useful for targeting and policy purpose. Identification of vulnerable households is done by setting a cut-off value of index, which requires some judgment. A common practice is to set the cut-off value at the mean of the indexes, which is found to be 0.51 from the HIES data. So we consider a household vulnerable if its vulnerability index is higher than 0.5, and non-vulnerable otherwise.⁹ The HIES data allows us to also calculate a household's vulnerability by season, because, as mentioned before, household's food consumption reflects a seasonal pattern. We reported the aggregate measure of vulnerability in table 4 which shows that the overall national level rural vulnerability was 48.7 in 2005 compared to 64.8 in Rangpur. Although vulnerability, like poverty, has declined over the years, it is still high and higher in Rangpur than in other regions.

The estimates of food poverty and food vulnerability by region and season are presented in Table 6. There are three important observations that can be made from this table. First, share of food vulnerable households has declined over time in all regions of Bangladesh. For

Table 6: Distribution of food poverty (FP) and vulnerability (FV) by season (%)

Period	Greater Rangpur		Rest of the country	
	2000	2005	2000	2005
<i>Monga</i> season	FP=92.0 FV=96.0	FP=79.2 FV=58.3	FP=79.4 FV=83.9	FP=73.3 FV=51.6
<i>Non-monga</i> season	FP=87.7 FV=88.5	FP=81.8 FV=52.5	FP=73.2 FV=75.6	FP=71.0 FV=49.2
All seasons	FP=88.6 FV=90.2	FP=81.2 FV=53.8	FP=74.9 FV=77.9	FP=71.5 FV=49.8
Observations	440	520	4,600	5,520

Sources: HIES surveys, 2002 and 2005.

⁸ We first regress household per capita consumption expenditure (log form) against household and village characteristics, and predict both the log consumption and the residual. Next, the squared residual is regressed against the same household and village-level regressors to get the estimated variance. Finally, we compute the vulnerability index after calculating the right hand side of equation (3.2).

⁹ An alternative cut-off point practiced in vulnerability analysis is 0.50, which is very close to what we find from HIES data (0.51).

example, 90.2 percent rural households in greater Rangpur were food vulnerable in 2000, which dropped to 53.8 percent in 2005. The corresponding figures for the rest of the country were 77.9 in 2000 and 49.8 percent in 2005. Second, food vulnerability in all regions is higher during *monga* period than in non-*monga* period. Third, the extent of food vulnerability is higher in Rangpur than in non-Rangpur region for both seasons. That is, households in greater Rangpur are more vulnerable to food poverty than those in the rest of the country—which is true in both *monga* and non-*monga* periods and has not changed much over time.

Table 7: Share of food vulnerable households in extreme poor and nonpoor households (%)

Extreme poverty status	Greater Rangpur		Rest of the country	
	2000	2005	2000	2005
Poor households	100.0	66.5	96.7	68.8
Non-poor households	77.9	44.7	68.3	43.5
Observations	440	520	4,600	5,520

Sources: HIES surveys, 2002 and 2005.

The question is, who are these vulnerable households? We can assume that most of these vulnerable households are already extremely poor. In fact, as Table 7 shows, more than 95 percent of the extreme poor were food vulnerable in 2000 (for Rangpur region this figure is 100 percent). However, this situation improved over time in both regions. For example, in 2005, 66.5 percent of the extreme poor were found vulnerable to food poverty in Rangpur, which is still a large number. This suggests that current high level of poverty of a household may be a major factor in deciding its vulnerability.

An important issue to look at in any vulnerability analysis is whether a household's vulnerability is due to consumption volatility (occasional or unexpected consumption shortfall of the household that is otherwise non-poor) or structural poverty (perpetuity of consumption shortfall of the household that is already poor). This is important for policy interventions, as different types of vulnerability may need different types of interventions. By looking at the current poverty situation of a vulnerable household we can assess the type of vulnerability that the household has. We do so for all food-vulnerable households in the HIES data. As reported in Table 8, vulnerability due to structural poverty is high and pervasive throughout Bangladesh in both 2000 and 2005. The share of structurally vulnerable households in greater Rangpur (calculated from Table 8) is 93 percent and 95

Table 8: Consumption volatility and structural poverty among food vulnerable households

Food vulnerability type	Greater Rangpur		Rest of the country	
	2000	2005	2000	2005
All vulnerable	90.2	53.8	77.9	49.8
Vulnerability due to consumption volatility	6.3	2.5	13.1	3.2
Vulnerability due to structural poverty	83.9	51.3	64.8	46.6
Observations	440	520	4,600	5,520

Sources: HIES surveys, 2002 and 2005.

percent in 2000 and 2005 respectively. The corresponding figures for the rest of the country are 83 percent and 94 percent respectively. Thus we see that households that have already low levels of food consumption constitute an overwhelmingly large share of households vulnerable to seasonal food deprivation.

One drawback of the HIES data is that it is not a household panel but *thana* panel.¹⁰ A household panel would have allowed us to examine the change in vulnerability over time for the same household. However, the InM survey data allows us to look at the food intake status for each household in both *monga* and non-*monga* periods (reported in Table 5). The food intake status of each household can be presented in a transition matrix, as shown in Table 9, where we see the changes in status over time between non-*monga* to *monga* period. If we assume a household's consumption status during non-*monga* period as *ex post* and the same during the *monga* period as *ex ante*, we can define vulnerability to The

Table 9: Transition of food-deprived households between *monga* and non-*monga* periods (N=480,918)

		<i>Monga</i> period			
		Occasional starvation	Food rationing	Consumption of full meals	Total
Non- <i>Monga</i> period	Occasional starvation	0.056	0.029	0.001	0.086
	Food rationing	0.366	0.137	0.005	0.508
	Consumption of full meals	0.051	0.317	0.038	0.406
	Total	0.473	0.483	0.044	1.00

Sources: InM survey 2006.

food intake status of each household can be presented in a transition matrix, as shown in Table 9, where we see the changes in status over time between non-*monga* to *monga* period. If we assume a household's consumption status during non-*monga* period as *ex post* and the same during the *monga* period as *ex ante*, we can define vulnerability to seasonal (*monga*) deprivation as the percentage of households remaining in or falling into food deprivation during the *monga* season. Accordingly, vulnerability to seasonal food deprivation among the hardcore poor in greater Rangpur is 95.6 percent. Out of this, 58.8 percent is likely to be structurally vulnerable (because they experience starvation in both lean

Table 10: Household perception about suffering in a future *monga* by food deprivation during *monga* period (N=480,918)

		Exposure of last <i>monga</i>			
		Occasional starvation	Food rationing	Consumption of full meals	Total
Perception about future <i>monga</i>	Suffering is not likely	0.055	0.119	0.012	0.186
	Suffering is somewhat likely	0.032	0.222	0.030	0.284
	Suffering is very likely	0.386	0.142	0.002	0.530
	Total	0.473	0.483	0.044	1.00

Sources: InM survey 2006.

¹⁰ A *thana* is an administrative unit containing roughly 20-30 villages.

and non-lean seasons) and 36.8 percent is vulnerable because of consumption volatility (because they experience meal rationing or starvation during the lean season only). Similar to the HIES findings, we see that share of structurally vulnerable households in all vulnerable households is higher. But unlike HIES findings, InM data shows that a substantial percentage of households are vulnerable because of volatility in food intake.

The InM data also allows us to define household's vulnerability to seasonal deprivation as the rate of anticipated seasonal deprivation. Households were asked for their perception about falling into food deprivation during the following *monga* season. Using this perceptive measure as household's *ex ante* exposure to seasonal hunger, we can operationalize the concept of vulnerability to seasonal hunger.

Table 10 shows a transition of household status by anticipated and actual exposure of seasonal hunger. Among those who face occasional starvation (47.3 percent) during exposed *monga*, 38.6 percentage points anticipate that they are very likely to face seasonal food deprivation during the following *monga*, with only 3.2 percentage points are somewhat likely to suffer, and 5.5 percentage points not likely to suffer. Among those who are forced to ration meals during *monga* season (48.3 percent), 14.2 percentage points fear the prospect of suffering to be very likely. Structural vulnerability can be defined as the share of those who suffered during last *monga* and at the same time fear the prospect of future suffering. Accordingly, structural vulnerability to seasonal hunger is found to be 78.2 percentage points or 96 percent of all vulnerable households.

4. Seasonal Hunger and Seasonality of Income

We find that seasonal hunger and its vulnerability are mostly structural in nature and not so much due to consumption volatility. If so, we wonder if seasonal hunger and its vulnerability are at all influenced by seasonality of income. This section deals with this question.

For the HIES data, consider an outcome variable P_{ijs} (seasonal deprivation status of household i in village j in season s) would depend on two types of income (earned income, and non-earned income), seasonal dummies, prices and preferences. Following Deaton (1991) and Paxson (1993), let us write the following consumption-based poverty equation:

$$P_{ijs} = \alpha\tau_s + \beta_0 R_j + \beta_1 X_{ij} + \beta_2 \ln Y_{ij} + \beta_3 \ln S_{ijs} + \gamma(S_{ijs} * \tau_s) + \delta(R_j * \tau_s) + \varepsilon_{ijs} \quad (4.1)$$

where Y_{ij} is household non-earned income which is assumed not to be seasonal, S_{ijs} is earned income which is subject to seasonality, X_{ij} is a vector of household and village level characteristics including prices and preferences influencing the outcome, R_j is a set of regional dummies, and τ_s is set of seasonal dummies representing the seasons.¹¹ ε_{ijs} is a mean zero disturbance term that reflects unmeasured determinants of P_{ijs} that vary across households. The earned income is interacted with seasonal dummy to measure if households encounter an idiosyncratic income shock. Thus, seasonality of income matters if $\gamma \neq 0$. On the other hand, seasonal dummies are interacted with regional dummies to test if the influence of seasonality varies across households with varying regional residence. This is a measure of aggregate shock as opposed to the idiosyncratic shock captured by γ . The aggregate shock matters if $\delta \neq 0$.

¹¹ It is assumed that the sample is uniformly distributed over the entire period of the year, with enough observations from all seasons to carry out the analysis.

Table 11: Summary statistics of selected explanatory variables

Variables	2000	2005	Panel
Per capita earned income (Tk./month)	649.9 (1,939.5)	627.4 (834.9)	638.4 (1,483.2)
Per capita non-earned income (Tk./month)	226.2 (546.4)	273.4 (679.0)	250.3 (618.0)
Education of HH head (years)	2.65 (4.04)	2.86 (4.13)	2.78 (4.09)
Sex of HH Head (1=M, F=0)	0.91 (0.28)	0.89 (0.31)	0.90 (0.30)
Age of HH head (years)	44.6 (13.6)	46.0 (13.9)	45.3 (13.8)
HH land asset (decimals)	84.1 (252.7)	149.9 (316.1)	117.6 (288.6)
HH non-land asset (Tk.)	105,826.7 (229,549.8)	147,393.3 (101,911.0)	128,485.7 (179,223.8)
HH has electricity (1=yes, 0=no)	0.19 (0.39)	0.30 (0.46)	0.24 (0.43)
Village distance to nearest district (km)	30.1 (17.9)	31.6 (29.9)	30.8 (24.8)
Proportion of village land irrigated	0.61 (0.29)	0.62 (0.32)	0.61 (0.31)
Village has any primary school (1=yes, 0=no)	0.85 (0.36)	0.93 (0.26)	0.89 (0.32)
Village has any secondary school (1=yes, 0=no)	0.52 (0.50)	0.93 (0.26)	0.73 (0.45)
Village has any agricultural bank (1=yes, 0=no)	0.13 (0.34)	0.15 (0.35)	0.14 (0.35)
Village has Grameen Bank (1=yes, 0=no)	0.14 (0.35)	0.23 (0.42)	0.18 (0.39)
Village has FFW program (1=yes, 0=no)	0.67 (0.47)	0.30 (0.46)	0.48 (0.50)
Village has VGF program (1=yes, 0=no)	0.60 (0.49)	0.65 (0.48)	0.62 (0.48)
Observations	5,040	6,040	11,080

Note: Figures in parentheses are standard deviations.

Sources: HIES surveys, 2002 and 2005.

Table 12: *Thana*-level FE-IV estimates of extreme poverty and food vulnerability

Selected explanatory variables	Basic Model		Extended Model	
	Extreme poverty	Food vulnerability	Extreme poverty	Food vulnerability
Per capita earned income (Tk./month)	-0.309 (-19.77)	-0.118 (-15.99)	-0.221 (-5.30)	-0.118 (-6.68)
Per capita non-earned income (Tk./month)	-0.081 (-21.11)	-0.029 (-15.80)	-0.086 (-18.07)	-0.029 (-14.30)
Per capita earned income* <i>Monga</i> period	-	-	-0.426 (-2.34)	-0.002 (-0.02)
Year (0=2000, 1=2005)	-0.205 (-4.96)	-0.030 (-1.52)	-0.234 (-4.91)	-0.029 (-1.44)
<i>Monga</i> period	0.035 (1.62)	0.029 (2.82)	2.573 (2.38)	0.036 (0.08)
<i>Monga</i> period*Greater Rangpur	-	-	-0.067 (-0.77)	0.024 (0.66)
R ²	0.071	0.0104	0.054	0.104
Hausman test for endogeneity	F(1,7432)= 518.713 p>F=0.000	F(1,7432)= 306.577 p>F=0.000	F(2,7429)= 267.247 p>F=0	F(2,7429)= 152.659 p>F=0
Observations	7,640	7,640	7,640	7,640

***Note:** Income variables are expressed in log form. Earned income and its interaction are endogenous and so instrumented. Instruments include village level infrastructure and regional agro-climate variables. Figures in parentheses under the coefficients are t-statistics. Regressions include other household (head's sex, age, education, and land and non-land asset) and community prices of consumer goods, daily wage, etc.

Sources: HIES surveys, 2002 and 2005.

Using HIES surveys of 2000 and 2005, we could use *thana*-level fixed-effects (FE) method to eliminate any bias due to unobserved *thana*-level heterogeneity influencing both income and poverty. Moreover, as measurement errors in consumption are likely to be correlated with measurement errors in income, we shall instrument earned income. The instruments for the earned income (S) are the production constraints such as rainfall which are assumed to influence income only and not consumption directly. We use two-stage FE method to estimate a pooled poverty regression across 2000 and 2005.

Table 11 presents the summary statistics of the explanatory variables. Table 12 presents two sets of results for each model specification. One specification includes the interaction of regional dummy with the seasonal dummy and the other specification does not have this interaction. We used *thana*-level FE method to the data sets of 2000 and 2005 by restricting the sample to *thanas* that are common to both years. Also included in the tables are results of Hausman endogeneity test, which justify the appropriateness of the two-stage IV model.

In both models, both earned and non-earned income reduces the incidence as well as vulnerability of seasonal food deprivation, with the effect of earned income being much more pronounced than that of non-earned income. According to basic model, incidence and

vulnerability of seasonal hunger are higher during lean season than non-lean season. For example, food vulnerability is 2.9 percentage points higher during *monga* period than in non-*monga* period. However, according to the extended model, when earned income (which is seasonal) and regional dummy are both interacted with *monga* dummy, we find that *monga* only matters to the incidence and but not to the vulnerability of seasonal deprivation.

More importantly, our results suggest that total yearly income (both earned and non-earned) does not completely explain variations in seasonal deprivation. Therefore, an increase in earned income during *monga* season is found to have an independent effect on poverty or vulnerability. Thus, idiosyncratic shock matters to the incidence of extreme poverty during *monga* season. For example, a 10 percent increase in earned income during *monga* can reduce extreme poverty by 0.43 percentage point. However, a rise of earned income does not influence *monga*-specific vulnerability.

Does seasonal income also influence seasonal hunger for the extreme poor? We use the InM survey data on food intake during *monga* and non-*monga* periods to investigate this question. Note that unlike the HIES, InM data do not have information on either seasonal or total income. Nonetheless, we use seasonal food intake and yearly food intake to explain the distribution of food intake for households across two periods of study (that is, *monga* and non-*monga* periods). We construct an ordering outcome of food starvation by combining household's food intake status during *monga* and non-*monga* in the following way: 1=household suffers occasional starvation during either *monga* or non-*monga* periods, or both periods, 2=households do not suffer from occasional starvation at all during either period but adopt food rationing during either period as they see fit, and 3=households have full meals during both *monga* and non-*monga* periods. Since this outcome variable is an ordered variable (meaning outcome 3 is better than outcome 2, and the outcome 2 is better than outcome 1, an ordered probit model is run against a set of explanatory variables including seasonal variables.

Formally, if the ordered values of an outcome Y (say, meal consumption status) are given by $m=1, 2, 3, \dots, M$, then the probability of observing a particular value m is given by,

$$\begin{aligned} P(Y = m) &= P(\kappa_{m-1} < \sum_k \beta_k X_k + \varepsilon \leq \kappa_m) \\ &= \Phi(\kappa_m - \sum_k \beta_k X_k) - \Phi(\kappa_{m-1} - \sum_k \beta_k X_k) \end{aligned} \quad (4.2)$$

where X is a vector of explanatory variables including seasonal income, and $\Phi()$ is the standard normal cumulative distribution function. This ordered probit explains year-round food deprivation status, conditional on chronic hunger (if households have less than full meals during both *monga* and non-*monga* periods) and seasonal hunger (if households have less than full meals only during *monga* season). Note that these two measures of hunger included in the right hand sides of equation (4.2) are either seasonal or chronic food starvation.¹²

Besides the conditional seasonal and chronic hunger dummies, we include in (4.2) employment status of household main occupation and a vector consisting of household asset variables including landholding.¹³ We employ *thana*-level fixed-effects (FE) method to

¹² *Thana*-level FE is used to eliminate unobserved *thana*-specific heterogeneity that affects the joint distribution of seasonal hunger and seasonal income.

¹³ Income information is not available in InM data, and hence has to be proxied for.

Table 13: Estimates of impacts of income seasonality on food intake in greater Rangpur

Household characteristics	Ordered probit estimates of meal consumption	Marginal effects on		
		Occasional starvation	Food rationing	Consumption of full meals
HH head is self-employed	-0.081 (-9.23)	0.032 (9.19)	-0.032 (-9.19)	-0.0001 (-9.24)
HH head is wage employed	0.079 (13.14)	-0.031 (-13.15)	0.031 (13.15)	0.00004 (11.40)
HH suffers from seasonal starvation	-3.453 (-20.56)	0.902 (29.98)	-0.892 (-16.28)	-0.009 (-38.67)
HH suffers from chronic starvation	-5.259 (-20.81)	0.978 (27.03)	-0.684 (-23.64)	-0.293 (-20.69)
HH head is self-employed*HH suffers from seasonal starvation	-0.004 (-0.26)	0.001 (0.26)	-0.001 (-0.26)	-0.00001 (-0.26)
HH head is wage employed*HH suffers from seasonal starvation	-0.115 (-11.18)	0.045 (11.15)	-0.045 (-11.15)	-0.0001 (-11.02)
Head's age (years)	-0.002 (-11.10)	0.001 (11.10)	-0.001 (-11.10)	-0.0001 (-9.96)
Dependency ratio	-0.017 (-1.60)	0.007 (1.60)	-0.007 (-1.60)	-0.0002 (-1.59)
Log of land asset (decimal)	0.056 (29.07)	-0.022 (-29.08)	0.022 (29.08)	0.00003 (17.89)
HH has agricultural asset	0.263 (27.71)	-0.103 (-28.07)	0.103 (28.06)	0.0001 (21.07)
HH has nonagricultural asset	0.118 (17.13)	-0.046 (-17.30)	0.046 (17.30)	0.0001 (12.35)
HH has cash savings	0.014 (3.00)	-0.005 (-3.00)	0.005 (3.00)	0.00001 (2.95)
HH has cow	0.065 (13.38)	-0.26 (-13.42)	0.026 (13.42)	0.00004 (11.02)
Pseudo R ²	0.425			
Observations	480,918			

***Note:** Figures in parentheses are t-statistics. The categories for ordered probit are 1=HH suffers from occasional starvation during *monga* or non-*monga* period, 2=HH occasionally does food rationing but does not suffers from occasional starvation during *monga* or non-*monga* period, 3=HH has full meals throughout the year.

Sources: InM survey, 2006.

control for the role of *thana*-level unobserved characteristics. Furthermore, the employment status is interacted with seasonal hunger dummy to proxy for the influence of seasonal income. This is expected to determine if food deprivation is caused by any change in earned income during the *monga* season. This is because employment is more scarce during

monga season than in non-*monga* season. Table 13 presents the *thana*-level fixed-effects (FE) ordered probit estimates (the first column) and the derived estimates of marginal effects for three outcomes considered (in the remaining columns).

Consider the marginal effects of selected variables of particular interest in this section. Both chronic and seasonal hunger are highly correlated with the probability of occasional deprivation (positively) and that of meal rationing and having full meal (negatively). This is expected, as either seasonal starvation or chronic starvation reduces the likelihood of the ordered ranking of starvation outcomes (from 3 to 2 to 1). On the other hand, the probability of occasional starvation is higher (lower) with self-employed (wage employed) with consequential lower (higher) probability of food rationing or full meal intake. This means, wage employed households are better-off than self-employed households on an average.

However, the status of relative food intake measured by relative starvation is unchanged for the wage-employed during *monga* season. That is, the intensity of seasonal starvation for the self-employed does not vary by season. But the intensity of starvation varies by season for the wage employed. This is shown by the coefficients of the interaction term of wage employment status and seasonal hunger status. We find that for the wage employed, the probability of worse option such as occasional starvation is high or the probability of better options such as food rationing or full meals is low during the lean season. That is, the wage-employed households are likely to starve more during the lean than non-lean season.

5. Mitigating Seasonal Poverty and its Vulnerability

Let us consider the role of alternate policies that affect both income and consumption and hence, help mitigate extreme poverty as well as seasonal vulnerability. We consider two outcomes - extreme poverty, and vulnerability to food poverty. We consider only extreme poverty as outcome because extreme poverty is the major underlying factor causing high vulnerability to seasonal hunger. We will use both HIES and InM survey data to estimate the following reduced-form equation. Consider the reduced-form deprivation equation as:

$$\Pr(V_{ijt} \leq z) = \beta X_{ijt} + \mu_j + \varepsilon_{ijt} \quad (5.1)$$

which is defined as the probability function of a household's observed hardship status in terms of observed exogenous household, village, and other characteristics (X) and unobserved area characteristics (μ) of i -th household living in j -th area (*thana*) in period t . For HIES data, we use a *thana*-level linear fixed-effects method to estimate (5), assuming that FE yields consistent estimates. The model is run for all seasons and then restricting only to households that were interviewed during the *monga* season. For all-season regression, we used *thana*-level FE but for *monga*-only regression a district-level FE is run. The results of two sets of outcomes are presented in Table 14.

Lack of human and physical capital endowments are major sources of both *ex ante* and *ex post* measures of poverty. Each additional year of education of household head can reduce extreme poverty by 1 percentage point and food vulnerability by 1.8 percentage point. Consequently, public investments in education infrastructure, such as primary and secondary schools, help reduce poverty and food vulnerability. Villages that have a primary school, for example, are likely to have extreme poverty reduced by 5.4 percentage points and *ex ante* food poverty by 9.6 percentage points. It has similar gains during lean period. Both land and non-land assets have strong negative effects on poverty, with the effects of

Table 14: Fixed-effects estimates of impacts of alternate policies on poverty and vulnerability

Explanatory variables	Extreme poverty (<i>thana</i> FE)	Food vulnerability (<i>thana</i> FE)	Extreme poverty during <i>Monga</i> period (district FE)	Food vulnerability during <i>Monga</i> period (district FE)
Year (0=2000, 1=2005)	-0.199 (-1.92)	0.057 (1.09)	-0.279 (-1.44)	0.296 (3.30)
<i>Monga</i> season (1=yes, 0=no)	-0.010 (-0.57)	0.002 (0.24)	-	-
Head's education (years)	-0.010 (-5.65)	-0.018 (-20.25)	-0.008 (-2.75)	-0.014 (-10.05)
Log of land asset (decimal)	-0.024 (-7.95)	-0.011 (-6.92)	-0.017 (-3.33)	-0.005 (-2.20)
Log of non-land asset (Tk.)	-0.078 (-15.41)	-0.026 (-10.15)	-0.079 (-9.13)	-0.027 (-6.67)
Household has electricity (1=yes, 0=no)	-0.111 (-8.13)	-0.111 (-16.14)	-0.124 (-5.68)	-0.110 (-10.89)
Village distance from nearest district (km)	0.002 (2.30)	-0.0004 (-1.20)	-0.002 (-0.74)	0.001 (3.03)
Proportion of irrigated land in village	-0.058 (-1.97)	-0.060 (-4.03)	-0.063 (-1.37)	0.017 (0.79)
Village has any primary school (1=yes, 0=no)	-0.054 (-1.82)	-0.096 (-6.35)	-0.075 (-1.63)	-0.040 (-1.87)
Village has any secondary school (1=yes, 0=no)	-0.048 (-2.12)	0.023 (1.03)	0.028 (0.86)	0.018 (1.19)
Village has any agricultural bank (1=yes, 0=no)	-0.022 (-0.91)	0.017 (1.35)	-0.041 (-1.01)	0.057 (1.50)
Village has Grameen Bank (1=yes, 0=no)	-0.062 (-2.80)	-0.031 (-2.91)	-0.083 (-2.48)	-0.001 (-0.07)
Village has FFW program (1=yes, 0=no)	0.028 (1.47)	-0.022 (-2.03)	0.040 (1.15)	-0.034 (-2.13)
Village has VGF program (1=yes, 0=no)	-0.032 (-1.97)	-0.019 (-2.32)	-0.117 (-3.59)	-0.004 (-0.24)
R ²	0.188	0.282	0.110	0.269
Observations	7,640	7,640	2,940	2,940

Note: Figures in parentheses are t-statistics. Regressions include other household (head's sex, age), village variables (distance to *thana*, prices of consumer goods, daily wage, etc.), and agroclimate characteristics.

Sources: HIES surveys, 2002 and 2005.

non-land asset being the strongest. For example, a one percent increase in land asset reduces extreme poverty by almost 2.4 percentage points, while a similar increase in non-land asset reduces extreme poverty by 7.8 percentage points. Same increase in land and non-land assets also reduces food vulnerability by 1.1 percentage points and 2.6 percentage points respectively. Therefore, a policy that stipulates asset transfer as a way to mitigate *monga* will have a beneficial effect if it focuses more on transferring non-land assets than land asset.

Electrification and land irrigation in village have also expected substantial negative effects on poverty and seasonal food deprivation. Households that have electricity are likely to have extreme poverty reduced by 11.1 percentage points, and food vulnerability by 11.1 percentage points. Electricity connection provides opportunities for both farm and non-farm income expansion which ultimately reduces poverty and seasonal food deprivation. Irrigation also increases farm productivity, thereby reducing both extreme poverty and food vulnerability by almost 0.6 percentage points for a 10 percent increase in village irrigation.

Provision of credit and safety net to help smooth consumption reduces poverty as well. Micro-credit programs such as Grameen Bank can reduce extreme poverty by as high as 6.2 percentage points and food vulnerability by 3.1 percentage points. Presence of safety net programs in village (such as VGF, FFW) also lowers extreme poverty and food vulnerability.

The above results indicate that an average Bangladeshi household (irrespective of whether they are from Rangpur or non-Rangpur regions) benefit from public policies such as human capital investment, credit expansion, and targeted safety net program. Do some of these programs would also help the very poor, who are highly vulnerable to seasonality of income,

Table 15: Distribution of HHs by coping measure during *monga* (%)

<i>Monga</i> coping measures	Kurigram	Gaibandha	Nilphamari	Lalmonirhat	Rangpur	All districts
Advance labor sale	1.60 (12.53)	1.96 (13.86)	6.28 (24.25)	10.50 (30.66)	5.70 (23.19)	4.36 (20.42)
Advance crop sale	0.45 (6.69)	0.23 (4.78)	0 (0)	1.09 (10.38)	1.59 (12.51)	0.54 (7.33)
Advance asset sale	12.11 (32.63)	17.03 (37.59)	0 (0)	18.50 (38.83)	10.51 (30.66)	11.35 (31.72)
Migration	41.82 (49.33)	37.96 (48.53)	24.75 (43.16)	50.37 (50.00)	27.44 (44.62)	35.99 (48.00)
Government and non-government support	29.17 (45.46)	32.55 (46.86)	41.59 (49.29)	22.96 (42.06)	26.97 (44.38)	31.67 (46.52)
Formal loan	2.28 (14.91)	4.26 (20.20)	9.90 (29.87)	7.46 (26.28)	7.21 (25.86)	5.79 (23.35)
Informal loan	4.73 (21.22)	7.46 (26.27)	25.28 (43.46)	17.34 (37.86)	11.69 (32.12)	12.38 (32.94)
No coping	36.07 (48.02)	34.66 (47.59)	31.00 (47.95)	27.62 (44.71)	43.65 (49.60)	34.75 (47.62)
Observations	120,426	128,987	102,866	56,772	71,867	480,918

Note: Figures in parenthese are standard deviations.

Sources: InM survey 2006.

especially in greater Rangpur? We can investigate that policy question using InM data; but before we do so let us check what the poor do to cope with seasonal deprivation. A better understanding of coping strategies of the poor will help relevant policymaking.

Table 15 presents a summary of coping mechanisms adopted by the poor during the *monga* of 2006 in greater Rangpur. The extreme poor of greater Rangpur are found to adopt a variety of measures to cope with *monga*. Yet some 35 percent could not adopt any mechanism to cope with seasonality in income and consumption. Some 30 percent received some support (mostly food) during the lean season from the government and non-government sources. Only less than 6 percent obtained loan from formal sources and some 12 percent from informal sources. It is worth noting that a large majority among the very poor (36 percent), however, sought seasonal out-migration to cope with lack of employment in local areas. Some 16 percent also adopted advance sale of labor, crop or assets.

Table 16 shows the distribution of households with these measures by main occupation of the poor households—self-employment, wage employment and unemployment. We find that use of alternative coping measures is typical for households belonging to alternative categories of occupation. Therefore, we argue that an increase in income and access to

Table 16: Distribution of households by coping measure and by main occupation (%)

<i>Monga</i> coping measures	Self-employed	Wage-employed	Others
Advance labor sale	3.00 (17.16)	4.75 (21.27)	4.37 (20.44)
Advance crop sale	1.05 (10.21)	0.18 (4.28)	0.92 (9.52)
Advance asset sale	14.62 (35.34)	9.73 (29.63)	12.57 (33.15)
Migration	31.70 (46.53)	39.27 (48.84)	32.32 (46.77)
Government and non-government support	24.96 (43.27)	33.06 (47.04)	32.73 (46.92)
Formal loan	5.59 (22.98)	5.71 (23.20)	6.04 (23.82)
Informal loan	11.95 (32.44)	12.61 (33.20)	12.20 (32.73)
No coping	40.12 (49.01)	33.19 (47.09)	34.72 (47.61)
Observations	76,358	260,822	143,738

Note: Figures in parentheses are standard deviations.

Sources: InM survey 2006.

credit and safety net programs are expected to help the extreme poor no matter what is their main occupation. In particular, encouraging seasonal out-migration during *monga* season will help mitigate seasonality of income, when lack of employment is widespread among the poor in greater Rangpur.

Table 17: Reduced-form estimates of household's vulnerability during *monga* period in Rangpur

Household characteristics	Ordered probit estimates of food deprivation	Marginal effects on			Means
		Occasional starvation	Food rationing	Consumption of full meals	
Head's age (years)	-0.003 (-23.14)	0.001 (23.14)	-0.001 (-23.11)	-0.0002 (-22.94)	39.98 (12.68)
Dependency ratio	0.014 (1.52)	-0.005 (-1.52)	0.005 (1.52)	0.0009 (1.52)	0.63 (0.21)
Log of land asset (decimal)	0.117 (22.27)	-0.046 (-32.27)	0.039 (21.42)	0.007 (16.87)	8.20 (12.59)
HH head is self-employed	0.027 (4.57)	-0.011 (-4.57)	0.009 (4.59)	0.002 (4.49)	0.16 (0.37)
HH head is wage employed	-0.019 (-4.34)	0.007 (4.34)	-0.006 (-4.34)	-0.001 (-4.33)	0.54 (0.50)
HH has agricultural asset	0.280 (22.26)	-0.111 (-22.27)	0.093 (22.32)	0.018 (25.56)	0.49 (0.50)
HH has nonagricultural asset	0.170 (29.97)	-0.067 (-30.30)	0.055 (31.15)	0.012 (26.45)	0.13 (0.34)
HH has cash savings	0.095 (24.89)	-0.038 (-24.94)	0.032 (25.07)	0.006 (23.92)	0.34 (0.47)
HH has cow	0.083 (20.52)	-0.033 (-20.57)	0.028 (20.72)	0.005 (19.63)	0.26 (0.44)
Village has safety net programs	0.051 (10.14)	-0.020 (-10.14)	0.017 (10.08)	0.003 (10.43)	0.10 (0.16)
Village has micro-credit programs	0.107 (9.93)	-0.043 (-9.93)	0.037 (9.77)	0.006 (10.96)	0.97 (0.18)
Proportion of high land in the district	5.251 (19.80)	-2.090 (-19.82)	1.756 (22.50)	0.333 (15.40)	0.81 (0.08)
Average yearly rainfall in district (mm)	0.092 (13.08)	-0.037 (-13.04)	0.031 (13.23)	0.006 (16.26)	198.54 (6.62)
Pseudo R ²	0.100				
Observations	480,918				

Note: Figures in parentheses are t-statistics except for last column where they are standard deviations. The categories for ordered probit are 1=HH suffers from occasional starvation, 2=HH occasionally does food rationing, 3=HH has full meals during *monga*.

Sources: InM survey, 2006.

How effective are actually these policies in mitigating *monga* in greater Rangpur? We estimate an equation similar to equation (4.2) but in reduced-form (where the seasonal and chronic seasonal dummies are excluded) using the InM data. We use *thana*-level fixed-effects ordered probit method to estimate the observed status of households in terms of seasonal hunger. Our objective is to find out whether some of the policies as identified in the analysis of HIES data could in fact help address the extreme form of regional and seasonal food insecurity. The ordered probit estimates with marginal impact coefficients of three outcomes are shown in Table 17. The results suggest that the probability of seasonal hunger is very much context-specific and is partially determined by agroclimate and location factors.¹⁴ Favorable rainfall helps reduce the incidence of seasonal hunger, as evidenced from the marginal impacts on occasional starvation. Seasonal starvation is also much less in highland areas, meaning favorable impacts of less probability of flood during pre-harvest period of *aman* rice.

More importantly, the results confirm that even after netting out the influence of agroclimate and location factors, most of the policies identified in the HIES analysis do indeed help reduce seasonal hunger among the hardcore poor in greater Rangpur. Thus, transfer of land, agricultural asset and/or non-agricultural asset reduces seasonal hunger. A 10 percent increase of landholding, for example, reduces the probability of occasional starvation during *monga* period by almost 0.5 percent. Similarly, income transfer during *monga* season, which is equivalent to having cash savings, reduces the vulnerability to seasonal hunger. Micro-credit programs also help reduce the incidence of seasonal hunger. For example, villages with micro-credit programs have some 4.3 percentage points lower incidence of occasional starvation during *monga*. Similarly, safety net programs are found to redress the incidence of occasional starvation by 2 percentage points during *monga*, thereby increasing the incidence of food rationing or full meals. Therefore, the coverage and scale of operation of micro-credit and safety net programs should be expanded so that they play an important role in redressing seasonal starvation among the most vulnerable households.

6. Conclusions

In greater Rangpur, *monga* is an acute form of seasonality in food consumption that causes food deprivation what Sen (1981) calls lack of entitlement to food. Lack of food entitlement is a result of economic and non-economic (such as agroclimate) forces that also prevent the poor from having access to job and other forms of economic and social security. In this sense, households who suffer from seasonal food deprivation are vulnerable to seasonality. Seasonality is due to agricultural crop cycle which is often manifested in household consumption through seasonality of income. Seasonality of consumption may also be influenced by seasonal preferences. In order to curb the role of agricultural seasonality in consumption and hunger, policies are directed mostly to influence seasonality of income, rather than seasonality of preferences.

Analysis of HIES data suggests that household consumption is much lower in greater Rangpur region than that in other regions, and seasonal fluctuations in consumption are also greater in the Rangpur region than that in the rest of the country. Although consumption is, in general, low all over Bangladesh during *monga* period (September–November), the shortfall is much more pronounced in greater Rangpur region than that in

¹⁴ Endogeneity of some of the explanatory variables is possible with such cross-sectional data. Unfortunately, we do not have instruments to control for any such possible endogeneity. We include rainfall and agroclimate variables to control for such endogeneity.

other regions. The extent of rural extreme poverty is also higher in *monga*-affected areas (41.9 percent) than that in non-affected (24.9 percent) areas in 2005.

The poverty figures are *ex post* measures of household wellbeing, and are thus snapshots of a particular time. But vulnerability to poverty, defined as the probability of being poor in the future or *ex ante* poverty, is also high in the greater Rangpur region. Although 2005 figures from HIES data suggest that vulnerability has declined over time in all regions, it nevertheless remains higher in *monga* areas than in non-*monga* areas. Vulnerability is caused by high volatility in consumption, persistent low consumption or both. As *monga* is a manifestation of seasonal deprivation, we would expect higher incidence of vulnerability due to high consumption volatility in the Rangpur region. But surprisingly, HIES data suggest that consumption volatility contributes very little to overall food vulnerability in both regions. This forces us to conclude that food vulnerability in rural Bangladesh is overwhelmingly a structural phenomenon.

Households in an agrarian society manage seasonality through consumption of produced goods, self-insurance (use of buffer stock) or mutual insurance (through interfamily transfers), and other means, all as part of their crop cycle. Incidence and severity of seasonality in agriculture, such as *monga*, indicate a failure of these means. It is also a failure of public policies and programs that are intended to provide necessary safety net to people in managing seasonality and, hence, *monga*. Government institutions employ short-term measures such as cash transfers, food-for-work, food coupons, and public works to manage *monga*. If variations in consumption were only transitory in nature and are idiosyncratic across households, these interventions would probably have helped rural households handle *monga* seasonality. But as we have seen, *monga* occurs more because of chronic (structural) poverty caused by low income and productivity than of transitory seasonal fluctuation in income. So interventions that are not geared toward enhancing income and productivity throughout the year are perhaps not much of help to contain *monga* in greater Rangpur.

Nonetheless, our results show that targeted policies and programs have favorable impacts on seasonal income, poverty and vulnerability. Micro-credit programs and other targeted schemes like VGF and FFW reduce both seasonal poverty and vulnerability. Yet only 7 percent of the rural population in greater Rangpur area has access to formal credit in 2005. Access to credit must therefore be improved to mitigate seasonal hunger and poverty. Similarly, only 10 percent of the villages in greater Rangpur have access to safety net program. For sustainable impacts on extreme and seasonal poverty reduction, both the coverage and scope of these programs need to be expanded. A recent example of targeted interventions in *monga*-affected area is *Char* Livelihood Project (CLP), introduced by the government of Bangladesh and funded by Department for International Development (DFID). This program makes asset transfer to the extreme poor in greater Rangpur. We find that an asset transfer program seems more effective for non-farm activities than for farm activities.

Non-targeted programs such as public investments in electrification, irrigation, and schools are expected to promote income and productivity of rural people in general (engaged in both farm and non-farm production), and can therefore help a lot in mitigating seasonal poverty such as *monga*. Private investments, too, in schooling or irrigation can help promote overall income and consumption growth and reduce poverty and seasonality.

All the policies and programs discussed here can help reduce seasonal deprivation in a piecemeal way. If these policies and programs are followed with a longer vision in mind, they are expected to jointly reduce extreme poverty and vulnerability substantially. Since *monga*

causes extreme poverty, food poverty and vulnerability, an all-out effort that combines these policies should be undertaken simultaneously to target vulnerable households in greater Rangpur. This is a major undertaking and may not be feasible for a single agency. Therefore, we recommend that a pilot program with such multi-sector and multi-thematic approach be initiated and evaluated properly to justify a more enhanced coverage and scope to contain *monga* once and for all.

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For information please contact:



Institute of Microfinance (InM)

- 2/1, Block-D, Lalmatia, Dhaka-1207, Bangladesh
 - PKSF Bhaban, Plot: E-4/B, Agargaon Administrative Area, Sher-e-Bangla Nagar, Dhaka-1207, Bangladesh
- Tel: 880-2-9126240-9
Fax: 880-2-8152796, 880-2-9134431
Email: info@inm.org.bd

Or visit

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