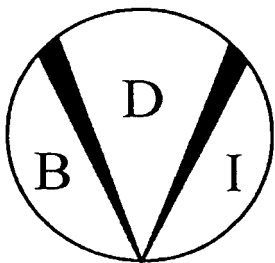


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MAINTAINING FOOD SECURITY IN THE WAKE OF A NATURAL DISASTER: POLICY AND HOUSEHOLD RESPONSE TO THE 1998 FLOODS IN BANGLADESH

Carlo del Ninno
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ABSTRACT

In 1998, Bangladesh was devastated by the worst flood of the century. At their peak, the 1998 floods covered two thirds of Bangladesh, causing severe damage to the major rice crop and threatening the food security of tens of millions of households. Ultimately, well-functioning private markets, suitable government policies, and public and NGO interventions combined with effective private coping strategies to prevent a major post-disaster crisis. This paper summarizes the results of several research reports and other publications in describing how the 1998 flood affected food security in Bangladesh at the national and household levels, the response of the government to the crisis, and the coping strategies employed by the households themselves. Much of the analysis summarized in the paper is based on a panel data set covering 750 households in flood-affected regions in three rounds over a 13-month period. The study finds that private imports, made possible by trade liberalization in the early 1990s, helped to stabilize markets and limit increases in rice prices, thereby dampening the adverse effects of higher prices on household calorie consumption. Private sector borrowing, a major household coping strategy, also played a key role in helping households to maintain consumption. However, long-term debts increased, making these households more vulnerable to future shocks. Additional public interventions, including investments in agricultural research and rural infrastructure, programs to reduce chronic malnutrition, and targeted transfer and credit-programs to disaster-affected households, could further mitigate the impact of natural disasters in the future.

Introduction

In Bangladesh, poverty, hunger, and malnutrition are widespread, and the struggle to achieve food security is ever present for tens of millions of people. About half of the population is still too poor to afford enough food to sustain a healthy and productive life. Nonetheless, the country has made substantial progress since the mid-1970s in enhancing food security by increasing production of rice and wheat, improving its infrastructure, making food delivery to the poor more efficient, and liberalizing its markets.

In 1998, Bangladesh was devastated by the worst flood of the century. At its peak in early September 1998, the flooding covered two-thirds of Bangladesh, causing severe damage to the major rice crop (2.2 million tons of rice crop losses, equal to 10.45 percent of target production in 1998/99) and threatening the food security of tens of millions of households.

In spite of the damage to the rice harvest and major disruption of the rural economy and employment opportunities, no famine or major food crisis occurred. Very few flood-related deaths occurred, and reportedly none occurred due to food shortages. Poor households did suffer substantial hardship during and after the floods, but the combination of well-functioning private markets and government, donor and NGO interventions to a large extent maintained availability of and access to food.

Overall, though, the success in handling the effects of the 1998 flood stands in sharp contrast to the famine caused by the flood in 1974 that contributed to tens of thousands of deaths in 1975.

This paper summarizes the results of several research reports and other publications' in describing how the 1998 flood affected food security in Bangladesh at the national and household levels, the response of the government to the crisis, and the coping strategies employed by the households themselves. It then highlights policy lessons for the management and reduction of the adverse impact of future natural disasters.

The analysis summarized in this paper is based on secondary data on market prices, imports and production, along with primary data from a multi-round survey of 757 households in seven flood-affected thanas, conducted in December, 1998 (about two-and-a-half months after the floodwaters had receded), April-May, 1998, and December, 1999.²

Foodgrain Markets and the Policy Response in 1998

At the sectoral level, the Government of Bangladesh (GOB) and donor officials were keenly aware of the potential flood damage to the main monsoon season (aman) rice crop and threat to foodgrain availability, even while the immediate relief operations were underway. Thus, the GOB launched an appeal for

international flood relief and food aid in August, 1998, anticipating that by the time the floodwaters receded, it would be too late to replant a large portion of the aman rice area. Donors ultimately responded by delivering 1.233 million tons of food aid in 1998/99, but in the short-run (October through December 1998), government distribution of foodgrains was constrained by the lack of available public stocks. Thus, public foodgrain distribution from July through December 1998 was only 26 thousand tons greater than planned before the flood.

Despite only a small increase above previously scheduled supplies through government channels in the last six months of 1998, markets were stabilized by private sector imports of rice and wheat. Inflows of 1.3 million tons of rice from India during this period (and over 2.5 million tons of rice by June, 1999)³ kept prices from rising above import parity levels following the flood (Figure 1). Evidence from letters of credit for rice imports shows that large numbers of traders participated in the (mostly overland) rice import trade, with an average contract size of 269 tons in 1998. Thus, private markets appear to have worked competitively to limit the price increases in the immediate post-flood period to only 12.4 percent from May-July to August-December, 1998. Moreover, price variations were of a similar magnitude across various regions of Bangladesh -- further evidence of well-functioning domestic markets.

A Comparison With Earlier Major Production Shortfalls

Thus, private sector imports played a major role in stabilizing rice and wheat markets following the 1998 floods. Government policy in two earlier periods of major food grain production shortfalls caused by floods in 1974 and 1988 depended much more on public sector market interventions. In 1974, a large-scale famine resulting in 30,000 to 100,000 deaths followed floods that damaged aus and aman rice crops (normally harvested in July-August and November-December, respectively). In contrast, the 1988 floods resulted in an even sharper fall in aman production (similar to that in 1998), but no famine occurred.

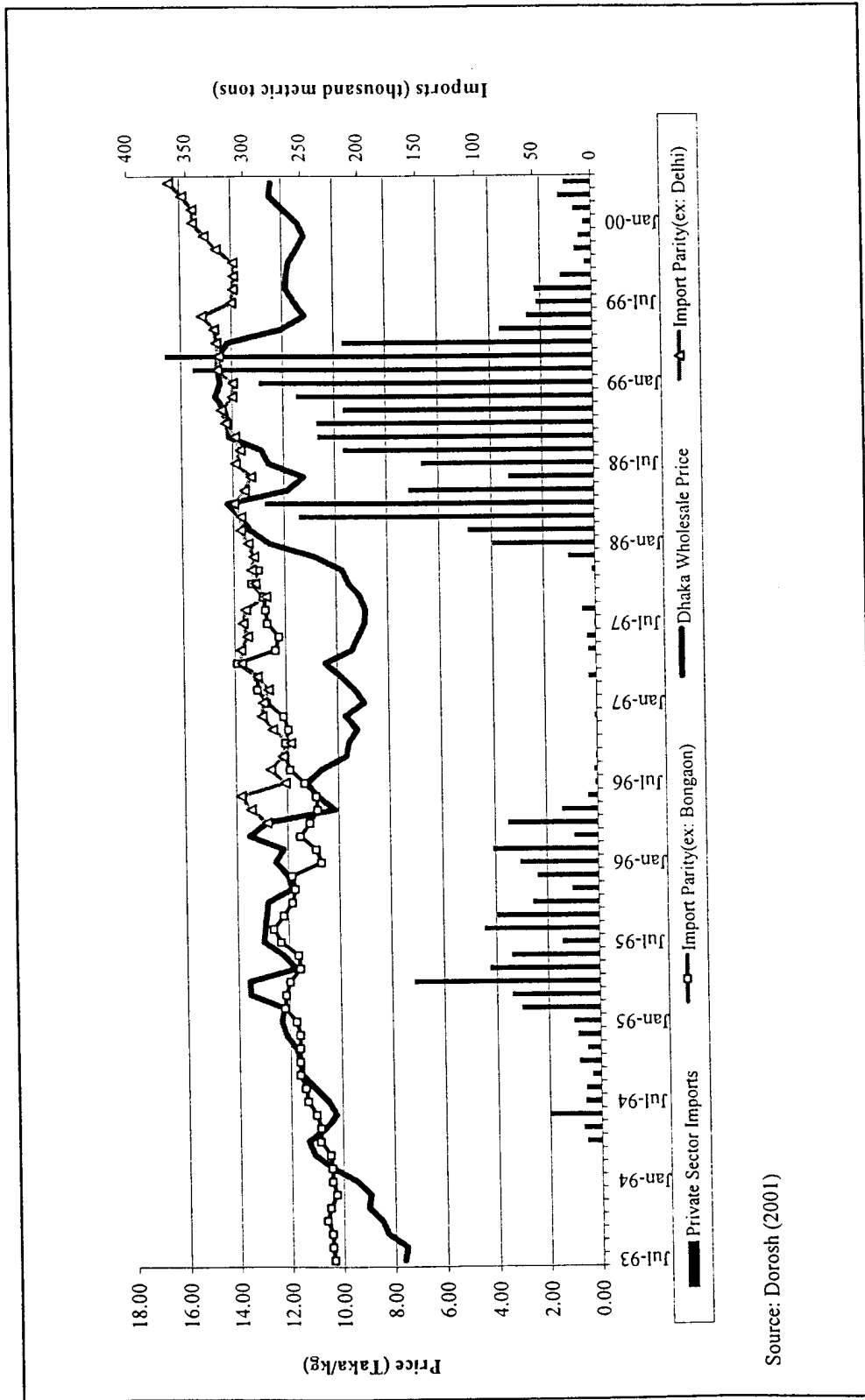
The 1974 famine was characterized by a very sharp rise in nominal (and real) rice prices following the floods in July. Rice prices in August through November 1974 were on average 58.2 percent higher than in May through July 1974. This sharp rise in prices had disastrous consequences for poor households lacking the entitlements to acquire enough of their staple commodity.⁵ Ravallion (1990) argued that this large increase in rice prices was a major cause of famine deaths, as calorie consumption fell below survival thresholds. In contrast to 1974, however, rice prices rose by only 7.0 percent in these months following the floods in 1988/89 and by 12.4 percent in 1998/99.⁶

This difference in market price behavior is not explained by the size of the production shortfall. As shown in Table 1, in comparison to trend aman rice production, the aman shortfalls in 1988 (18.1 percent) and 1998 (18.0 percent) were much larger than the 1974 aman shortfall (8.5 percent). Instead, speculative behavior by traders appears to have

⁷ played a major role in the 1974 price increase. In addition, traders appear to have believed (correctly) that the government would be unable to intervene effectively to stabilize market prices in the event of a production shortfall because of extremely low public stocks at the time of the flood (only 27 thousand tons at the end of July 1974), shortage of foreign exchange reserves for commercial imports, extremely high world foodgrain prices, and delays in U.S. food aid deliveries.⁷ Public foodgrain stocks and distribution appear to have played a major role in limiting market price increases in 1988/89. Total per capita foodgrain stocks in August through November 1998 were 10.9 kilograms per person, about four times those in the same period in 1974/75. These higher stocks enabled much higher foodgrain distribution in the critical post-flood months than in 1974/75. Public foodgrain distribution from August through November in 1988 was 931 thousand tons, 272 thousand tons greater than in the same months in 1974.

Stocks in 1999/99 were also significantly larger than in 1974/75 in the crucial August through November months - 669 thousand tons, or 5.3 kilograms per person, twice the per capita stocks of

Figure 1—Rice prices and quantity of private rice imports in Bangladesh, 1993-2000



Source: Dorosh (2001)

1974/75, though half those of 1988/89.9 Increases in market supplies of rice and wheat through private imports and replenishment of government stocks through food aid deliveries several months after the flood stabilized prices and enabled the government to expand distribution even in the absence of large stocks.

Several factors suggest that the need for public stocks to avert famines in Bangladesh has considerably decreased since 1974, however. First, the record 10.55-million-ton boro harvest in May/June 1999, only five to six months after the failure of the aman crop, shortened the period of uncertainty regarding domestic supply, increasing foodgrain availability, raising farmer incomes, and reducing prices.¹⁰ Second, as shown above, private sector imports have added to domestic supplies and quickly stabilized prices at import parity levels following aman crop shortfalls in 1997/98 and 1998/99. Third, rice markets in Bangladesh are now much better developed than in 1988/89, and especially as compared to 1974/75, so shortages across regions within the country can be more easily met by domestic private (and public) grain flows. (Public sector imports, an alternative to private sector imports, encountered serious problems with tenders in 1998/99 and were not a significant source of supply.) Fourth, foreign exchange constraints, which so severely hampered government efforts to procure rice in 1974, had been greatly eased through increased export earnings and availability of commercial and official credit. Fifth, international markets for rice and other grains have grown deeper and more stable, so the risk of facing high international prices has lessened."

Losses of Crops, Assets and Earning from Employment

Despite success in stabilizing markets, households still suffered because of the floods." Crop losses (particularly rice crop losses) due to the flood were substantial: 45.7 percent of households that produced a crop in the previous 12 months suffered crop losses, averaging Taka 2,975, equivalent to 29 percent of their production.

For the 55 percent of households that lost assets, their average loss was Taka 6,936, equivalent to 16 percent of the total value of their pre-flood assets. In all, 47 percent of households suffered damage or loss to housing, with the average loss equal to Taka 5,675, or 59 percent of pre-flood housing value.

The rural economy suffered serious disruption from the floods as well. Average monthly days of paid work went down in the period of the flood, but increased in the period after the flood to the same level as twelve months before the flood for all workers except daily laborers. Daily laborers were most affected as their employment fell sharply from 19 days per month in July through October 1997 to only 11 days per month in the same months in 1998. Similarly, wage earnings also declined during the floods and had not recovered to 1997 levels by October-November, 1998. For daily laborers, average monthly earnings in July-October, 1998, were 46 percent below those in the same months in 1997, and in October-November, 1998, they were still 18 percent below the 1997 levels (Figure 2). This decline in number of days worked and wage earnings occurred in the context of a labor market with little open unemployment. Thus, underemployment increased as workers worked fewer days, but most workers found at least some employment.

Within eight months of the flood, as agricultural production and rural employment recovered, household incomes rose substantially, both for flood-exposed households as well as those not directly exposed to the flood. The average monthly household income of all households in the sample was 45 percent higher in April 1999 than in

November 1998, and about 50 percent higher in November 1999. The income level of flood-exposed households also increased by 35 percent between November 1998 and April 1999 and by 49 percent between November 1998 and November 1999, but the income of poor flood-exposed households did not increase as much as the rest of the households (Figure 3).

Food Consumption

In the first few months after the flood, borrowing from the informal sector enabled households to increase spending on key non-food items (health, housing and fuel), while maintaining total expenditures on food. Average total household expenditures were actually higher in November 1998 (Taka 4,001) than in April 1999 (Taka 3,663) or November 1999 (Taka 3,508).

However, because of higher prices of rice, vegetables, and many other food items in November 1998, actual calorie consumption in this period was significantly less than in the two subsequent periods (2,249 calories/person/day compared to 2,518 and

Table 1: Availability, stocks and market prices in major flood years in Bangladesh

	1974/75	1988/89	1998/99
Rice production			
Aus (million metric tons)	3.00	2.86	1.62
Aman (million metric tons)	6.29	6.86	7.74
% below trend	-8.5%	-18.1%	-18.0%
Boro (million metric tons)	2.29	5.83	10.55
Total rice production (million metric tons)	11.58	15.55	19.91
Wheat production (million metric tons)	0.12	1.02	1.91
Total foodgrain production (million metric tons)	11.69	16.57	21.81
Per capita rice production (kilograms/person)	148.05	145.57	156.74
Aus and Aman share of production (percent)	80.3%	62.5%	47.0%
PFDS distribution (July - June)			
Total rice (thousand metric tons)	131	690	530
Total wheat (thousand metric tons)	1597	2251	1603
Targeted rice (thousand metric tons)	4	167	386
Targeted wheat (thousand metric tons)	157	1259	1488
Foodgrain imports (July - June)			
Private rice imports (thousand metric tons)	0	0	2663
Public rice imports (thousand metric tons)	267	61	393
Private wheat imports (thousand metric tons)	0	0	805
Public wheat imports (thousand metric tons)	2030	2075	1603
Total availability			
Rice availability (million metric tons)	10.42	14.32	20.61
Wheat availability (million metric tons)	1.7	3.12	3.87
Total foodgrain availability (million metric tons)	12.12	17.44	24.48
Per capita availability (kgs/person)			
Rice availability (kilograms /person)	133.26	134.07	162.31
Wheat availability (kilograms /person)	21.76	29.19	30.46
Foodgrain availability (kilograms /person)	155.03	163.26	192.77
National wholesale prices			
Rice: percent change'	58.2%	7.0%	12.4%
Wheat: percent change'	61.2%	15.3%	10.7%
Public foodgrain closing stocks			
Average (August - November)			
Rice (thousand metric tons)	21	621	359
Wheat (thousand metric tons)	187	546	310
Total (thousand metric tons)	208	1167	669
Total (thousand metric tons)	2.7	10.9	5.3
Foreign exchange reserves^a (US\$ million)	175	863	1744
Mid-year inflation (millions)	78.2	106.8	127

Source: del Ninno, Dorosh and Smith, 2001.

Note: a Percentage change from May-July average to August-November average

Figure 2 - Average Monthly Earnings by Occupation

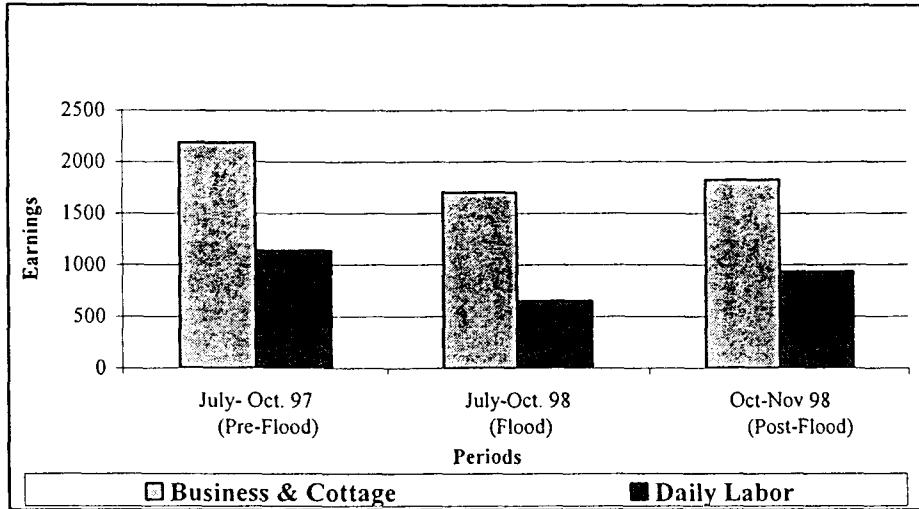
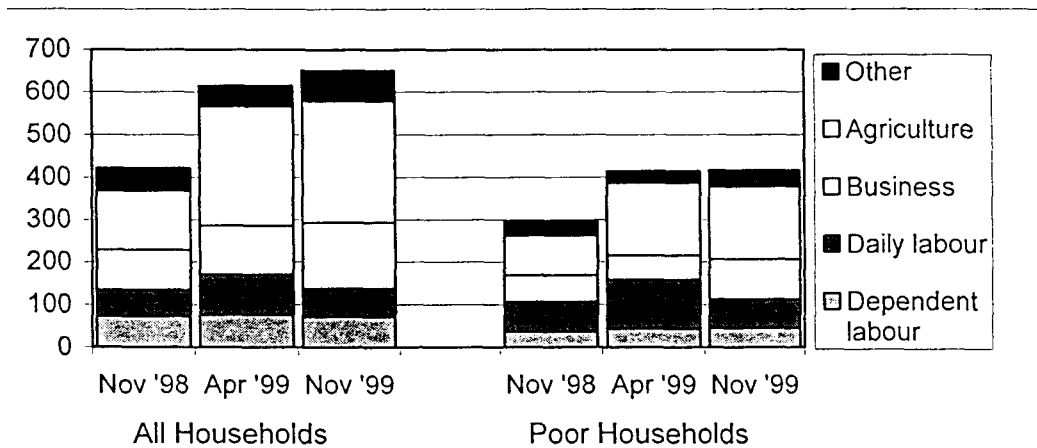


Figure 3 - Average Monthly Earnings by Occupation for Poor Flood-Exposed Households



2,526 calories/person/day), (Table 2). Calorie consumption of the poor was even more sharply affected. Calorie consumption of the poorest 40 percent of households was only 1,638 calories/capita/day in November 1998, as compared with about 2,200 calories/capita/day in April 1999 and November 1999.

Econometric analysis suggests that had rice prices increased even more than the 12.4 percent increase that actually occurred (from May-July average to August-November average), calorie consumption would have declined further. Without the private sector cross-border trade, rice prices would likely have been at least 19 percent higher (to a level equal to the import parity price of rice from Thailand) and total calorie consumption of the poor would have

fallen by an additional 44 to 109 calories/person/day to 1529 to 1596 calories/person/day (del Ninno, Dorosh and Smith, 2001). Food transfers also contributed to increased calorie consumption, though to a lesser extent. In absence of these transfers, per capita consumption would have fallen additional 20 to 25 calories/person/day.

Health and Nutrition

The flood also left a major deterioration in the quality of households' health environments in its wake, damaging or destroying peoples' homes and toilet facilities and reducing their access to safe drinking water. These factors, combined with the reduction in food consumption, led to substantial increases in illness--even after the floodwaters had receded

Table 2 — Mean Values of Household Expenditure and Caloric Consumption by Expenditure Categories, Time of Data Collection and the Flood Exposure

	November 1998		April 1999		November 1999	
	Not Exposed	Exposed	Not Exposed	Exposed	Not Exposed	Exposed
	All	All	All	All	All	All
Household Expenditure						
Food	2,629	2,740	2,709	2,687	2,521	2,707
Non-Food	1,215	1,324	1,293	755	828	866
Total	3,844	4,064	4,001	3,442	3,348	3,573
Bottom 40%						
PC Total Expenditure	415	424	422	465	500	505
Share of food	77.76	72.62	73.9	80.09	79.69	78.86
Middle 40%						
PC Total Expenditure	748	743	745	674	664	670
Share of food	72.89	69.85	70.82	79.89	74.81	76.98
Top 20%						
PC Total Expenditure	1,394	1,434	1,423	1,052	1,051	1,033
Share of food	57.81	62.89	61.44	74.48	74.25	72.57
All						
PC Total Expenditure	761	747	751	679	685	674
Share of food	68.23	67.86	67.97	78.21	75.89	76.21
PC Daily Calories						
Bottom 40%	1,745	1,602	1,638	2,143	2,218	2,193
Middle 40%	2,653	2,325	2,428	2,778	2,680	2,528
Top 40%	3,049	3,140	3,114	3,176	3,204	3,015
All	2,411	2,184	2,249	2,637	2,623	2,486
Household Size	5.05	5.55	5.4	5.06	4.92	5.40
Number	217	540	757	214	213	519

Source: del Nimno, Roy and Mukherjee, 2001

partially or totally: 9.6 percent of individuals in the sample suffered from diarrhea, and 4.7 percent were affected by respiratory illness in the immediate post-flood period (November, 1998). While adolescents had the greatest increase in illness, the most serious health problem posed by the flood was the illness among children (del Ninno, Dorosh, Smith and Roy, 2001).

The flood also led to increases in both wasting and stunting among preschool children: severe or very severe flood exposure caused many children to lose weight and/or to fail to grow at a critical period in their mental and physical development. This situation was brought about by a combination of factors, including reduced access to food, the increased difficulties of providing proper care for children that came with disruptions in home life, and the greater exposure of children to contaminants.

For poor households, these adverse effects on nutrition were not merely short-term, however. In November 1998, 65 percent of children in flood-exposed households were stunted. This figure actually rose to 70 percent by April 1999, perhaps because of a lag between a period of deprivation and the resulting malnutrition. By November 1999, the percentage of stunted children in flood-exposed households had fallen back to 65 percent, the same level as twelve months earlier. Stunting declined dramatically for children in non-flood-exposed households, however, from 57 percent in November 1998 to only 44 percent one year later. The econometric analysis by del Ninno and Lundberg, 2001, confirms that 15 months after the flood (November 1999), most children appear to have regained the same nutritional status they had a few months after the flood (November 1998). Unfortunately, those children that had a very poor nutritional status in November 1998 ' and that were exposed to the flood (more than 40 percent of the sample), had not regained the same level of nutritional status a year later.

Mitigating the Effects of the Flood: Government Food and Cash Transfers

In response to the flood, the government of Bangladesh used two main direct transfer relief

programs. In the initial flood period, immediate relief through the Gratuitous Relief program went mainly to seriously flood-exposed households; 35.7 percent of severely flood-exposed households received the transfer compared to 9.7 percent of nonflood-exposed households. Vulnerable Group Feeding transfers started in late October and were targeted administratively through union-level committees. They were better targeted to the poor than to the flood-exposed households: 38.8 percent of the households in the bottom quintile received grain transfers compared to 17.2 percent and 11.2 percent in the top two quintiles (Figure 4). However, almost 20 percent of the non-flood-exposed households received transfers, as well. (del Ninno and Dorosh, 2001)

The survey suggests that government direct transfers were for the most part well-targeted to flood-exposed households and to the poor. Yet, government transfers were small relative to the needs of households, as indicated by the share of the transfers compared to the monthly expenditure.

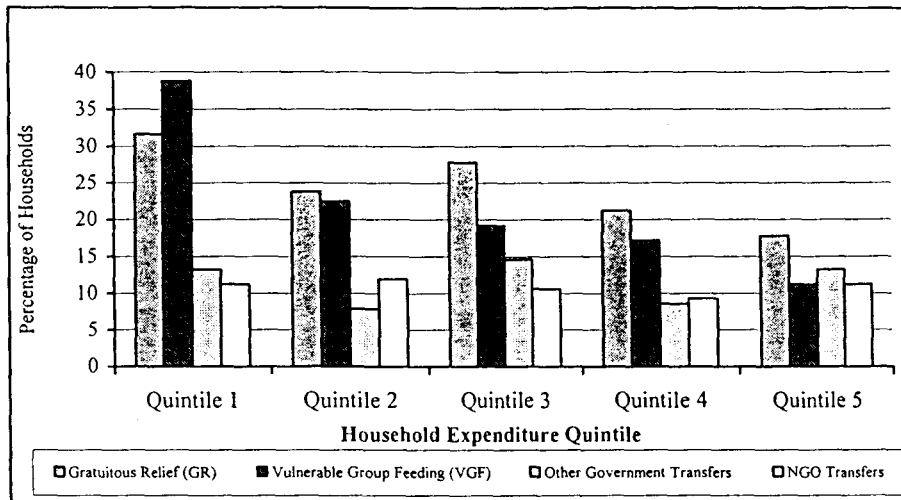
Small cash transfers were part of the initial flood relief efforts, but larger cash transfers or credit programs were not part of the medium-term relief to households two to four months after the floods, even though foodgrain stock constraints limited the expansion of the Vulnerable Group Feeding program during this period.

Household Response to the Flood

Households adjusted to the shock of the flood in several major ways: reducing expenditures, selling assets, and borrowing. Borrowing to purchase food and to fund other expenses (such as education and health, farming, business, repayment of loans, marriage and dowry, purchases and mortgage of land/agricultural equipment purchases, etc.) has been the most important coping strategy employed by households in Bangladesh after the flood, both in terms of the value of the resources and the number of households who borrowed.

More than 60 percent of poor, flood-exposed households in the sample borrowed money in the months immediately following the flood, and of these

Figure 4 - Households Receiving Transfers by Expenditure Quintile



more than half borrowed money for food. Household debts rose to an average of 1.5 months of typical consumption compared with only a small percentage of monthly consumption in January 1998, about 8 months before the floods (Table 3). This borrowing was sufficient to maintain household levels of expenditures in value terms vis-à-vis pre-flood level, but because of higher prices, poor flood-exposed households consumed only 1,602 calories per capita per day, suggesting that targeted cash transfers and credit programs could have been an effective complement to direct food distribution. Households borrowed mostly from non-institutional sources such as friends and neighbors rather than from NGOs and banks. Interest rates on the loans ranged from 21 percent from institutional sources to a maximum of 67 percent.

The percentage of households with outstanding debt one year after the flood decreased progressively from November 1998, when it was at the highest with 66 percent of the households holding an average of Taka 7,937 in outstanding debt, to 54 percent in November, 1999 for Taka 6,497. Nevertheless, even though there has been an improvement in the number of households in debt and the amount of debt, it still constitutes a large share of the total expenditure and leaves those households vulnerable to further shocks, especially for the poorest 40 percent of the households (Figure 5).

Eliminating borrowing following the flood would have required a transfer of approximately Taka 5,000 (about USS100) for each of the 60 percent of

households still in debt in December 1998. Nationwide, total private borrowing by households may have reached USS10 to USS1.5 billion, equivalent to 15-20 percent of total government expenditures in 1998/99, compared to about \$0.6 billion of annual loan disbursement of Grameen and BRAC to-ether.

Conclusions

The studies summarized in this paper clearly showed that well-functioning private markets, suitable government policies, and interventions by government and nongovernmental organizations worked together with effective private coping strategies to prevent a major food-related disaster after the 1998 flood in Bangladesh. The country's trade liberalization of the early 1990s made possible the large-scale private sector rice imports following the flood, adding more than two million metric tons to Bangladesh's rice supply, stabilizing rice prices and preventing a further serious decline in calorie consumption of the poor. Government public foodgrain distribution was well-targeted to poor and flood-exposed households, improving household food security and helping offset some of the adverse effects of the flood by marginally increasing calorie consumption.

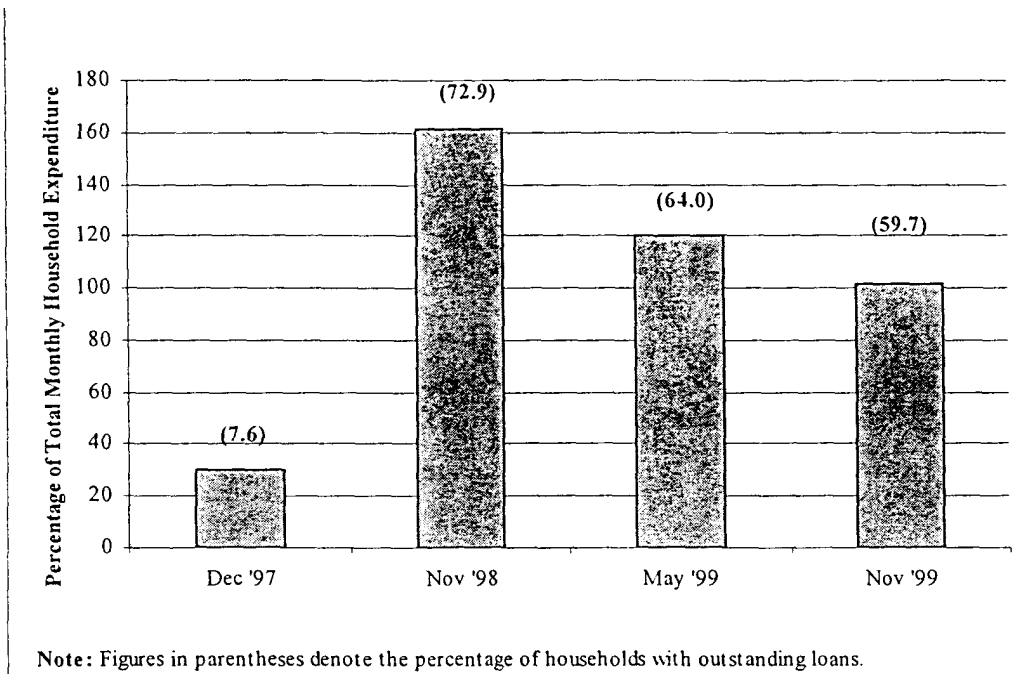
Although a major food crisis was averted, the poor did suffer, both in the short term through reduced consumption and increased illness and in the medium term through increases in household debt and lingering nutritional consequences.

Table 3—Coping strategies, flood exposure and poverty in November 1998

	Flood Exposed				All	Not exposed	All households
	Bot 40%	Mid 40%	Top 20%	Top 20%			
Monthly households expenditure (Tk)	2,414	3,974	7,721	4,064	3,844	4,001	
Share of food expenditures (percent)	72.4	69.5	62.2	67.4	68.4	67.7	
Households in debt (percent)	68.2	58.9	62.6	63.5	53.5	60.6	
Share of monthly expenditure (percent)	186.1	138.7	131.3	144.4	140.2	143.6	
Household purchasing food on credit (percent)	56.7	54.1	50.5	54.4	29.5	47.3	
Share of monthly expenditure (percent)	37.6	27.2	17.3	25.8	20.0	25.0	
Households receiving government transfers (percent)	60.7	54.1	32.7	52.6	33.6	47.2	
Share of monthly transfer on expenditure (percent)	3.4	2.4	0.8	2.0	2.1	2.0	
Households selling assets (percent)	25.2	21.3	15.9	21.9	20.3	21.4	
Share of monthly expenditure (percent)	45.5	51.3	75.3	51.9	44.2	49.9	
Number of households	226	207	107	540	217	757	

Source: del Ninno, Dorosh, Smith and Roy, 2001

Figure 5 - Outstanding Loans as a Percentage of Household Expenditure for the poorest 40 percent of Households



The major coping strategy of households in the first three months after the flood was to borrow from private sector sources. Over time, however, this reliance on private sector borrowing had adverse implications for food security and economic growth. Fifteen months after the flood, the country's poorest households still labored under high levels of debt.

Thus, the experience of the 1998 Bangladesh flood illustrates the crucial role that private markets and appropriate government investments and policies can play in maintaining food availability, limiting price increases and supplementing household access to food. Additional policy measures could further mitigate the negative impact of natural disasters. Continued investment in agricultural research and extension, along with appropriate trade and agricultural price policies to maintain adequate price incentives, are needed to increase agricultural productivity and rural incomes. Investments in marketing infrastructure (roads, rural electrification and telephones) and a policy of limited and transparent Public Foodgrain Distribution System (PFDS) market interventions that are careful to maintain incentives for private trade could promote further development of efficient and competitive foodgrain markets. Policies and programs to reduce chronic malnutrition among children can soften the

negative impact of natural shocks. Finally, carefully designed targeted transfer and credit programs for disaster-affected households could enable them to cope with shocks without accumulating long-term, high-interest debt.

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Endnotes

1. del Ninno, Dorosh, Smith and Roy (2001); del Ninno, Roy and Mukherjee (2001); del Ninno and Dorosh (2001); Dorosh (2001) and del Ninno, Dorosh and Smith (2001).
2. This survey was conducted as part of the Food Management and Research Support Project (FMRSP), funded by USAID-Dhaka.
3. The figures given are official statistics from the Bangladesh government. Calculations of implicit food demand and Indian export data suggest the figure may have been as much as 1.0 million tons lower (Dorosh, 2001).
4. The official death toll from the famine was 30,000 (Alamgir, 1980); unofficial reports cited in Sobhan (1979, p. 175) were as high as 100,000.
5. Wheat prices also rose by 61.2 percent in the same period.
6. See also Islam (1997) for a further discussion of the 1974 famine.
7. Ravallion (1985, 1990) provides econometric evidence that exaggerated reports of crop failure influenced traders' expectations and led to "excessive hoarding" of stocks.
8. Note also that in 1974/75, India was also

suffering from recent poor harvests and did not have large rice stocks to supply Bangladesh

9. Discouraging private speculation was a major Ministry of Food rationale for maintaining a relatively high level of stocks during these crucial months in 1998/99. Early assurances of food aid by donors may also have contributed to calming markets in Bangladesh.

10. The record 1.91-million-ton wheat harvest in March and April 1999 also added to food availability soon after the aman crop shortfall.

11. In addition, replacement of flood-susceptible deepwater aman cultivation by irrigated boro cultivation in cropping patterns has reduced the production risk associated with floods (Hossain, Bose and Chowdhury, 2001).

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12. For a detailed description of the survey and the definition of severity of flood exposure see del Ninno, Dorosh and Smith, 2001.

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