The 1998 Floods in Bangladesh

Disaster Impacts, Household Coping Strategies, and Response

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Foreword

Natural disasters such as prolonged droughts, floods, and cyclones threaten food security in many developing countries, directly reducing agricultural production and food supply. Moreover, these disasters can disrupt local economies and reduce households' access to food by destroying infrastructure and private productive assets, reducing employment opportunities, and lessening the profitability of private enterprises. The 1998 floods in Bangladesh led to a reduction in the main monsoon season rice crop of more than 10 percent of targeted production for the entire 1998/99 fiscal year and threatened the food security of tens of millions of people. But, as this report shows, a combination of well-functioning private markets, suitable government policies, public and NGO interventions, and effective private coping strategies prevented a major disaster.

This report combines a careful analysis of government policy and private foodgrain markets with a detailed survey of 757 households in rural Bangladesh in November and December 1998, about two months after the floodwaters receded. The report describes short- and medium-term government policy measures taken to encourage private trade, including an earlier trade liberalization that permitted private-sector imports of rice from India that stabilized private markets and largely offset the decline in production. The impact of the floods on household assets, employment, consumption, and nutritional outcomes is analyzed using the micro-level survey data. The study finds that flood-exposed households were, in general, able to avoid severe declines in food consumption and nutritional status through a combination of private-sector borrowing that averaged almost 6,000 Taka (Tk) per household (equivalent to over 140 percent of average monthly expenditures) and targeted government and NGO transfers that averaged 331 Taka per household.

This research report builds on earlier IFPRI work in Bangladesh analyzing the Public Foodgrain Distribution System and the behavior of rice and wheat markets. It also extends IFPRI work on preventing famines, efficiency in targeting of public-sector transfers, coping strategies, and determinants of nutritional outcomes. Most important, it provides an analysis of how appropriate government policy can both provide incentives for private markets to maintain food availability and directly reduce the food insecurity of poor disaster-exposed households through targeted transfers that increase access to food and minimize deterioration in nutritional status.

Per Pinstrup-Andersen
Director General

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Summary

The 1998 floods in Bangladesh, deemed "the flood of the century," covered more than two-thirds of the country and caused 2.04 million metric tons of rice crop losses (equal to 10.45 percent of target production in 1998/99). This flood threatened the health and lives of millions through food shortages (resulting from crop failure), the loss of purchasing power for basic necessities, and the potential spread of water-borne disease. Yet, in fact, very few flood-related deaths occurred, and reportedly none due to food shortages. Poor households did suffer substantial hardship during and after the floods, but the combination of well-functioning private markets, broadly effective interventions by government, donors, and nongovernmental organizations (NGOs), and private sector borrowing to a large extent maintained availability and access to food.

This report examines in detail how the floods affected food security in Bangladesh at the national and household levels and draws lessons for the management of future natural disasters in developing countries. At the heart of this analysis is the food security triad of availability, access, and utilization. Thus, we not only examine food production, imports, government interventions, and prices, which determine availability, but place a major focus on households' access to food (which was seriously threatened by loss of assets and income-earning opportunities) and utilization of food (including intrahousehold food distribution). The findings in this report are largely based on data from a survey of 757 rural households in 7 flood-affected regions (*thanas*), supplemented by analysis of secondary data on foodgrain markets and government policy.

As described in Chapter 2 (Figures 2.1 and 2.2), the availability of food—particularly rice and wheat, which together account for about 80 percent of the calories in the Bangladesh diet—is determined by domestic production (which was severely impaired by the floods), government net distribution on the domestic market (in turn determined by the availability of stocks, government commercial imports, and food aid), and private sector imports. Household access to food, however, requires not only well-functioning markets or effective government distribution programs, but also sufficient resources to acquire food (obtained through current incomes, transfers, savings, or borrowing). Intrahousehold distribution and the health environment ultimately determine individual consumption and nutritional outcomes, as well.

The Impact of the Floods on Foodgrain Markets and the Policy Response

At the sectoral level, the government of Bangladesh (GOB) and donor officials were keenly aware of the potential flood damage to the monsoon season rice crop (*aman*) and the threat

to foodgrain availability, even while the immediate relief operations were under way. The GOB therefore 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 with 1.233 million metric tons of food aid delivered in 1998–99, but, in the short run, government distribution of foodgrains was constrained by available public stocks. Thus, public foodgrain distribution from July through December 1998 was only 631,000 metric tons greater than planned before the flood.

In spite of 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 metric tons of rice from India kept prices from rising above import parity levels following the flood. Evidence from letters of credit for rice imports shows that large numbers of traders participated in the rice import trade (which was mostly overland), with an average size of contract of 710 metric tons in 1994/95. Thus, private markets appear to have worked competitively to limit the price increases to only 12.4 percent between May–July and August–December 1998 (compared with 58.2 percent in the same months in 1974 when a famine occurred) and to maintain availability of foodgrains. Adequate levels of government stocks—659,000 metric tons at the beginning of September 1998, compared with only 347,000 metric tons in September 1974—may have also helped stabilize markets by influencing private traders' expectations of the ability of the government to intervene in local rice markets.

Public stocks and distribution of foodgrains were significantly larger following the major floods in 1988. Several factors suggest that the need for large public stocks to avert famines in Bangladesh has decreased considerably since 1974 or even 1988, however. Large increases in the size of the *boro* rice crop, harvested only five to six months after the *aman* crop, have shortened the period of uncertainty regarding domestic supply, increased foodgrain availability, raised farmer incomes, and reduced prices. Trade liberalization in the early 1990s has enabled private sector imports to help stabilize prices and total supplies when production shortfalls threaten domestic supplies, and the availability of foreign exchange is no longer a severe constraint on imports. Moreover, 20 years of investment in rural infrastructure have improved the efficiency of domestic rice markets in Bangladesh, so shortages across regions within the country can be more easily met by domestic private (and public) grain flows. In addition, increases in real per capita incomes and food consumption over time have added to food security at household levels.

Losses of Crops, Other Assets, and Employment

During the 1998 floods, floodwaters on sample farmers' fields were almost double their normal levels—137 centimeters compared with 73 centimeters. On medium highland, floodwaters were on average 88 centimeters higher than in normal years and even high fields that normally are not flooded were covered by an average of 22 centimeters of water. This severe flooding led to substantial crop losses, especially to the *aus* and *aman* crops. Because of the floods, 69 percent of *aus* production, 82 percent of deepwater (broadcast) *aman,* and 91 percent of transplanted *aman* was lost, representing 24 percent of the total value of anticipated agricultural production for the year. Overall, rice crop losses accounted for over half of total agricultural losses, with vegetables (25 percent) and fibers (19 percent) accounting for most of the remaining losses.

In addition to the losses to crops, the floods damaged or destroyed many household assets, reducing household wealth as well as future productive capacity. For the 55 percent of households that lost assets, the average loss was 6,936 taka (Tk), equivalent

to 16 percent of their pre-flood total value of assets. In all, 47 percent of households suffered damage or loss to housing, the average loss being Tk 5,675, or 59 percent of the pre-flood value; 17 percent of households lost trees with an average value of Tk 5,137; 15 percent of households lost chickens, though the average loss was only Tk 142. The more severe the level of flood exposure, the larger the proportion of households suffering damage to their assets: 78 percent of the households exposed to very severe floods and 69 percent of those exposed to severe flooding lost assets worth on average Tk 9,042 and Tk 6,679, respectively.

The rural economy suffered serious disruption from the floods. Average monthly days of paid work decreased during the floods, but increased in the period after the floods to the same level as 12 months earlier for all workers except day laborers. Day laborers were the most severely affected: their employment fell sharply from 19 days per month in 1997 to only 11 days per month in July through October 1998. Wage earnings also fell during the floods and had not recovered to 1997 levels by October–November 1998. For day laborers, average monthly earnings in the period July–October 1998 were 46 percent below those in the same months in 1997, and in October–November 1998 were still 18 percent below 1997 levels. 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 people worked fewer days, but at least most workers found some form of employment.

Impacts on Household Food Security, Health, and Nutrition

The decline in crop production, losses of other assets, and lower employment opportunities contributed to increased food insecurity. Food consumption fell, along with households' abilities to meet their food needs on a sustainable basis. Vegetables and many other foods were in short supply, and as a consequence the calorie consumption of flood-exposed households was 272 calories/person/day fewer than that of households not exposed to flooding; 15.6 percent of flood-exposed households became food insecure. We found no evidence that females' consumption of the main staples—rice and wheat—was reduced by more than males' as a result of the floods, or that male favoritism in the consumption of animal products increased. Thus, the floods did not appear to lead to an increase in discrimination against females in food consumption within households.

The floods also caused a major deterioration in the quality of households' health environments. They damaged or destroyed people's homes, reduced their access to safe water, and destroyed or damaged their toilet facilities. These factors, combined with the reduction in food consumption, led to substantial increases in illness, even after the floodwaters had receded. In the immediate post-flood period, 9.6 percent of individuals in the sample suffered from diarrhea, and 4.7 percent were affected by respiratory illnesses. Individuals in all age groups experienced a deterioration in health status at this time, especially those who were severely or very severely flood exposed. Although adolescents had the greatest increase in illness, the most serious health problem posed by the floods was the increase in children's illness, because they suffered more serious consequences, even threatening their survival.

The floods 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—55 percent of children in the sample were stunted and 24 percent were wasted. 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. We also found some evidence that the

floods led to an increase in severe chronic energy deficiency among women.

Household Coping Mechanisms

Households adjusted to the shock of the floods in several major ways: reducing expenditures, selling assets, borrowing. Borrowing was by far the major coping mechanism of the households sampled, in terms of both the value of the resources and the number of households that borrowed. About 60 percent of households in the sample were in debt in the months immediately following the floods. Average household debt rose to an average of almost 1.5 months of typical consumption compared with only a small percentage of monthly consumption in January 1998, about eight months before the floods. In addition, 56.6 percent of flood-exposed households in the bottom 3 quintiles resorted to purchasing food on credit in the month preceding the survey. This borrowing was sufficient to maintain the value of household expenditures vis-à-vis pre-flood levels but, because of higher prices, poor flood-affected households consumed fewer calories per capita per day than non-flood-exposed households, suggesting that targeted cash transfers and credit programs could have been an effective complement to direct food distribution.

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

Our survey suggests that government direct transfers were well targeted to flood-exposed households and to the poor. 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 with 9.7 percent of non-exposed households. Vulnerable Group Feeding (VGF) transfers, which were administered through union-level committees, were better targeted to the poor than to the flood-exposed households. Among flood-exposed households, 35.4 percent of households in the bottom quintile received grain transfers compared to 17.8 percent and 7.5 percent in the top two quintiles, respectively.

Yet government transfers were small relative to the needs of households, as indicated by the extent of household borrowing (equal to about six to eight times the level of government transfers for poor, flood-exposed households). To eliminate borrowing would have required a transfer of approximately Tk 5,000 for each of the 60 percent of households that were in debt in December 1998, several months after the floods. Extrapolating this figure to the national level, the cost of such transfers would have been more than US$1.5 billion.

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

Policy Implications

Both short-term and long-term policies played major roles in preventing the 1998 floods from resulting in a major food security disaster in Bangladesh. Public sector investments in agricultural research and extension in the 1980s and 1990s, together with mainly private sector investments in small-scale irrigation, led to substantial increases in wheat and *boro* rice production. This made the country less vulnerable to floods by increasing total foodgrain production in the country, reducing the length of time between major crops from 12 months to only about 6 months, and leading to a shift away from highly flood-susceptible deepwater *aman* cultivation in the monsoon season to *boro* cultivation in the dry season. Continued investment in research and extension could further increase production efficiency and reduce the vulnerability of the food sector to floods.

In addition, long-term public investments in infrastructure (roads, bridges, electricity, and telephones) contributed to efficient mar-

keting systems that enabled the private sector grain trade to supply markets throughout the country following the floods. Government policies also encouraged private sector participation in the grain trade. In particular, the liberalization of rice and wheat imports in the early 1990s enabled private sector imports to quickly supply domestic markets and stabilize prices at their import parity levels following the floods. Short-term policies such as the removal of the import tariff on rice in early 1998 and instructions to expedite port clearance of private sector foodgrain imports also provided clear signals to the private sector of government support for this trade. Moreover, these private sector imports proved to be a far less costly way of maintaining foodgrain availability than the distribution of government commercial imports or public stocks, the mechanisms by which the government handled production shortfalls after the 1988 floods, 10 years earlier.

Donors responded to the flood situation with major increases in food aid that eventually permitted a major expansion of targeted foodgrain distribution through the Vulnerable Group Feeding and Food For Work programs. However, almost inevitable delays and uncertainties in food aid arrivals resulted in only a small net increase in public distribution beyond preflood plans until December 1998, in part because existing government stocks of wheat were insufficient to permit a large expansion in distribution. (Rice stocks were kept in reserve for possible use in stabilizing markets later.) A policy of holding more stocks might not have been a better option though, given the substantial costs of procuring, handling, and eventually distributing grain. With foodgrain supplies and prices stabilized by private sector imports, targeted cash transfers to supplement direct food transfers could have been used to increase household access to food (and other basic needs) without increasing market prices of foodgrains.

Nonetheless, programs already in place and a rapid expansion of the VGF program to more than 4 million households enabled public foodgrain distribution following the floods to be well targeted to the poor. Poor women and children, many of whom were chronically malnourished, were effectively targeted through the VGF program. Greater targeting of credit programs would have been useful, however, given that poor households borrowed heavily in the informal private market during the floods, and NGO credit programs were limited in scope. To avoid delays and to minimize leakages, these rural credit programs for disaster relief should be designed and put in place before disasters occur. Maintaining a structure of social programs that can be scaled up in the event of a disaster is more important than maintaining large stocks of food.

To reduce even further the impact of a future natural disaster like the floods of 1998, it is necessary to improve the scope and the quality of the interventions so as to provide food, water, and shelter at the time of the disaster and in its immediate aftermath. Relief should be targeted at both the village and individual levels. This report shows that interventions at the village level, such as providing shelter, improving sanitary conditions, and creating economic opportunities, were effective in alleviating the adverse impact of the floods. We also present evidence that targeting to individual poor, flood-exposed households can have a positive impact on the well-being of individual children. Finally, government policies to foster economic growth in rural areas and to provide income-earning alternatives to poor households can both help to reduce poverty as well as increase the capacity of households to withstand shocks resulting from natural disasters.

Conclusions

The combined efforts of the government of Bangladesh, donors, NGOs, and flood-affected households themselves, together with private trade operating in well-functioning markets, were in general extremely successful in mitigating the effects of the 1998 floods at the household level and in avoiding a major

food crisis. Thus, the Bangladesh example illustrates the importance of coordinated actions at the sectoral and household levels, by both public and private sectors, in maintaining the availability of and access to food to ensure food security following major supply disruptions. Private trade alone might have provided sufficient availability of food, though this in itself would not have solved the problem of access to food for millions of households. Public sector actions enhanced access to food by flood-exposed households, though these interventions were too small to have a major direct effect on overall availability and market prices. Ultimately, food security in Bangladesh was largely maintained through an appropriate mix of public interventions, private market trade flows, and an extensive system of private borrowing. Continued investments in agricultural research, extension, roads, electricity, and other rural infrastructure, along with policies promoting efficient markets and programs to provide targeted transfers and credit to poor households, could further enhance the food security of the poor.

CHAPTER 1

Introduction

> The nation is faced with a disaster of highest order. All signs, as they become more and more visible, lead to one conclusion: we are faced with a disaster with catastrophic dimensions. . . . It is not just another flood; it is THE FLOOD, which all Bangladeshis will remember for generations to come. . . . This will be the reference point for many of our national events. This will set the standard of our capability or incapability. We'll measure ourselves with this standard in future. So will the rest of the world.

These statements originally appeared in Professor Muhammad Yunus's article in *The Daily Star,* a major English-language newspaper in Dhaka, Bangladesh, on September 11, 1998, in the midst of what has been called "the flood of the century."[1]

Fortunately, such a tragedy did not occur. In spite of massive floods that covered more than two-thirds of the country, causing over 2 million metric tons (MTs) of rice crop losses (equal to 10.5 percent of target rice production in 1998/99) and threatening the health and lives of millions through possible food shortages, loss of purchasing power for basic necessities, and the potential spread of water-borne disease, very few flood-related deaths occurred, and reportedly none due to food shortages. Poor households did suffer substantial hardship during and after the floods, but the combination of well-functioning private markets, broadly effective interventions by government, donors, and nongovernmental organizations (NGOs), and private sector borrowing to a large extent maintained availability and access to food.

This research report documents what is to a large extent a success story about a famine that did not happen in spite of a massive food production shock. As von Braun, Teklu, and Webb (1999) argue, famines are complex events that involve institutional, organizational, and policy failure, not just generalized market- and climate-driven production failure. Moreover, famines must be understood in their long-term context. In the same way, the avoidance of a famine involves more than simply increasing food supply to areas affected by a national disaster. Thus, we examine in detail how the flood affected food security in Bangladesh at the national and household levels, and the response of government, donors, markets, and households to the potential food crisis. A key part of the story is the role of longer-term investments in agricultural research, extension, and irrigation, along with earlier policy reforms (namely,

[1] Professor Muhammad Yunus was the founder of the Grameen Bank. At about the same time (early September 1998), the British Broadcasting Corporation (BBC) quoted an international agency in reporting that 20 million people in Bangladesh might die as a consequence of the floods (Khan and Obaidullah 1999).

the trade liberalization in the early 1990s), which played a major role in making the 1998 outcome so much different from that of the Bangladesh famine in 1974.

At the heart of this analysis is the food security triad of availability, access, and utilization. The availability of food is naturally an important issue when a major production shortfall occurs. As this report will show, private sector imports played a crucial role in maintaining the availability of rice and wheat following the 1998 floods. The contribution of food aid to the availability and timing of food aid arrivals is also highlighted.

But, as emphasized by Sen (1981), Dreze and Sen (1989, 1991), and Ravallion (1997), another key determinant of household food security is households' food entitlements—their capacity to acquire food legally through their own production, income, savings, and private and government transfers (in other words, household access to food). Sen (1981), in fact, argues that insufficient entitlements can lead to famine and that loss of entitlements, rather than a significant decline in the total availability of food, was the major cause of the Great Bengal famine of 1943, which killed between 1.5 and 3.0 million people.[2] The poor are particularly vulnerable to natural disasters because of their lack of assets and inadequate food entitlements (World Bank 2000). This study examines how access to food was affected by the loss of assets and income-earning opportunities for flood-exposed households in 1998, using detailed income and expenditure data from a survey of rural households in flood-affected regions conducted just after the floods.

We do not stop at household access to food, though. Because sufficient access to food at the household level does not ensure adequate nutrition, especially for women and young children, we extend our analysis to cover the utilization of food (including intrahousehold food distribution). Thus, we also use household survey data to examine determinants of nutrition (such as individual food consumption, caring practices, and overall health status) as well as nutritional outcomes for children.

Even though the availability of food was maintained and targeted programs contributed to increasing access to food by the poor, this report shows that many households resorted to borrowing money in informal markets as their dominant coping strategy. Credit was also an important coping mechanism following the 1988 floods in Bangladesh, but inadequate access to credit by poor households at that time adversely affected nutrition, contributing to reduced child growth (Foster 1995). Thus, we also examine the extent to which poor households were able to borrow in 1998, and we discuss the implications of these increased debt burdens for the medium-term welfare of the poor.

The 1998 Floods

Floods are a normal part of the ecology of Bangladesh. The mid-1998 floods in Bangladesh were unusual, however, for both their depth and duration. Unlike the normal floods, which cover large parts of the country for several days or weeks during July and August, the floods in 1998 lasted until mid-September in many areas, killing hundreds of people and destroying roads, houses, crops, and other assets.

Three major rivers drain into the Bay of Bengal through Bangladesh: the Ganges (known as the Padma in Bangladesh), the Brahmaputra (known as the Jamuna in Bangladesh), and the Meghna. Less than 10 percent of the 1.55 million km^2 catchment area of these rivers lies within the borders of Bangladesh, so rainfall in neighboring India, Nepal, Bhutan, and China and snowmelt in the Himalayas are major determinants of the flow of water through Bangladesh. These three major rivers have their peak flows in July, August, and September, during the monsoon season, when they overflow their banks

[2] The official estimate of famine deaths was 1.5 million. The higher figure is a calculation of excess mortality during the famine period by Sen (1981), Appendix D.

Table 1.1 The 1998 floods: Chronology of events

Date	Event
1998	
First week of July	The Flood Forecasting and Warning Centre (FFWC) of the Bangladesh Water Development Board reports rising water levels in the major rivers.
July 16	First meeting of the Inter-Ministerial Disaster Management Co-ordination Committee (IMDMCC). Emergency relief operations begin.
July 24	First National Disaster Council (NDC) meeting chaired by the Prime Minister.
August 13	Second meeting of the IMDMCC. Government plans to cope with the flood situation with internal resources.
August 26	The government of Bangladesh appeals for international help to assist flood victims.
August	32,000 tons of rice and 1,100 tons of wheat distributed through relief channels: Gratuitous Relief (GR), Test Relief (TR), and Vulnerable Group Feeding (VGF).
September 7	Peak of floods in terms of number of monitoring stations reporting flows above danger levels; 51 percent of total area of Bangladesh inundated.
September	16,575 tons of food aid arrive through World Food Programme; 52,000 tons of rice and 1,800 tons of wheat distributed through relief channels.
September 25	Flood waters recede—all major rivers are below danger level.
October 1	Expansion of VGF program to 4 million cards, with 50 percent of the ration in wheat.
October	143,000 tons of government commercial wheat imports arrive; 42,500 tons of rice and 32,500 tons of wheat distributed through relief channels.
October	44,344 tons of food aid arrive, bringing total since August 1998 to 61,883 tons.
November	A total of only 77,000 tons of food aid are available for distribution by end of November. VGF program continues. Wheat distribution through relief channels (56,700 tons) is now greater than rice distribution through relief channels (37,800 tons).
Late November	138,902 tons of food aid arrive, bringing total since August 1998 to 200,785 tons.
November–December	*Aman* rice harvest of 7.74 million tons, 1.76 million tons below target.
December	Expansion of VGF program to 4.2 million cards and increase in the ration size from 16 kg to 20 kg/card (5 kg rice and 15 kg wheat).
December	360,887 tons of food aid arrive, bringing total since August 1998 to 561,672 tons.
1999	
February	VGF distribution extended to February through April 1999.
May–June	Record *boro* rice harvest of 10.05 million tons leads to drop in national average wholesale coarse rice price from 14.0 Tk/kg in April to 12.4 Tk/kg in June.

Source: Grameen Trust flood website.

and deposit fertile silt on the floodplains. These normal annual floods typically cover about 30 percent of the country at various times. However, in years when the peak water levels of all three rivers occur at the same time, as in 1954, 1974, 1987, 1988, and 1998, severe floods have occurred.[3] In addition to these major river floods, Bangladesh experiences flashfloods in the eastern and northern rivers, generally lasting only a few days, local floods due to high rainfall in the monsoon season, and coastal floods due to storm surges generated by cyclones.[4]

The 1998 floods began in early July in the southern part of Bangladesh and continued over the next three months in various parts of the country, inundating 68 percent of the total area at various times (a detailed chronology of the 1998 floods is presented in Table 1.1). Initially, flooding (caused by heavy rainfall) was mainly confined to the southeastern hilly basin and the Meghna basin in the northeast of Bangladesh. During the third week of July, however, a heavy on-rush of water in the Brahmaputra, which flows into Bangladesh from the north, added to rising levels in the Ganges (Padma) basin in the western part of the country. By July 28, 1998, 30 percent of the total area was inundated. Then, after two weeks of little change

[3] Pramanik (1994: 135, 144, 147).

[4] Shahjahan (1998). See Ali, Hoque, Rahman, and Rashid (1998) for a more in-depth discussion of the hydrology of floods in Bangladesh and the Flood Action Plan adopted after the 1988 floods.

in the flood situation, water levels in the Padma river started rising sharply. Shortly thereafter, other rivers also rose, so that by August 30, 1998, 41 percent of the total area was inundated. The flood situation reached its peak, in terms of the number of monitoring stations reporting flows above danger levels, on September 7, 1998, when 51 percent of the total area was inundated. Water levels fell rapidly thereafter, and by September 25, 1998, no monitoring stations reported flows above danger levels.[5]

Prior to 1998, the last major floods in Bangladesh occurred in 1987 and 1988. In 1987, floods covered about 40 percent of the land area, affected about 30 million people, and caused about 1,800 deaths. The floods in 1988 were even more serious, covering about 60 percent of the land area, affecting about 45 million people, and causing more than 2,300 deaths.[6] In terms of peak water levels at various river monitoring stations, the 1998 and 1988 floods were almost identical: they both averaged about 11.45 meters above danger level (Table 1.2). The major difference between the two floods was in the duration of the flooding: at the major river monitoring stations shown in Table 1.2, the water was above the danger level for an average of 59 days in 1998, compared with only 34 days in 1988.

Normal flooding has little adverse effect on rice production in Bangladesh (and, in fact, adds to soil fertility), but the long durations of both the 1988 and 1998 floods led to major production shortfalls (Figure 1.1). Initially, the 1998 floods caused only relatively minor damage to standing crops but, as floodwaters persisted into September, the flooding destroyed seedlings of the main monsoon season *aman* rice crop. Ultimately, the flood resulted in a shortfall in *aman* rice production of 1.76 million MTs and a total rice production shortfall of 2.04 million MTs, similar to the production loss due to floods in 1988.

Table 1.2 Bangladesh flood levels and duration, 1988 and 1998

	1988	1998	Difference 1998–1988
Total flood-affected area (km^2)	89,970	100,250	10,280
Percentage of total area	61	68	7
Peak water level (meters)			
Brahmaputra basin			
Bahadurabad (Jamuna)	20.62	20.37	–0.25
Aricha (Jamuna)	10.58	10.76	0.18
Mymensingh (Old Brahmaputra)	13.69	13.04	–0.65
Dhaka (Buriganga)	7.58	7.24	–0.34
Narayanganj (Lakhya)	6.71	6.93	0.22
Ganges basin			
Rajshahi (Padma)	19.00	19.68	0.68
Goalondo (Padma)	9.83	10.21	0.38
Bhagyakul (Padma)	7.43	7.50	0.07
Meghna basin			
Bhairab Bazar (Upper Meghna)	7.66	7.33	–0.33
Average	11.46	11.45	0.00
Days above danger level			
Brahmaputra basin			
Bahadurabad (Jamuna)	27	66	39
Aricha (Jamuna)	31	68	37
Mymensingh (Old Brahmaputra)	10	33	23
Dhaka (Buriganga)	23	57	34
Narayanganj (Lakhya)	36	71	35
Ganges basin			
Rajshahi (Padma)	24	28	4
Goalondo (Padma)	41	68	27
Bahgyakul (Padma)	47	72	25
Meghna basin			
Bhairab Bazar (Upper Meghna)	68	68	0
Average	34	59	25

Source: Bangladesh Water Development Board 1998.

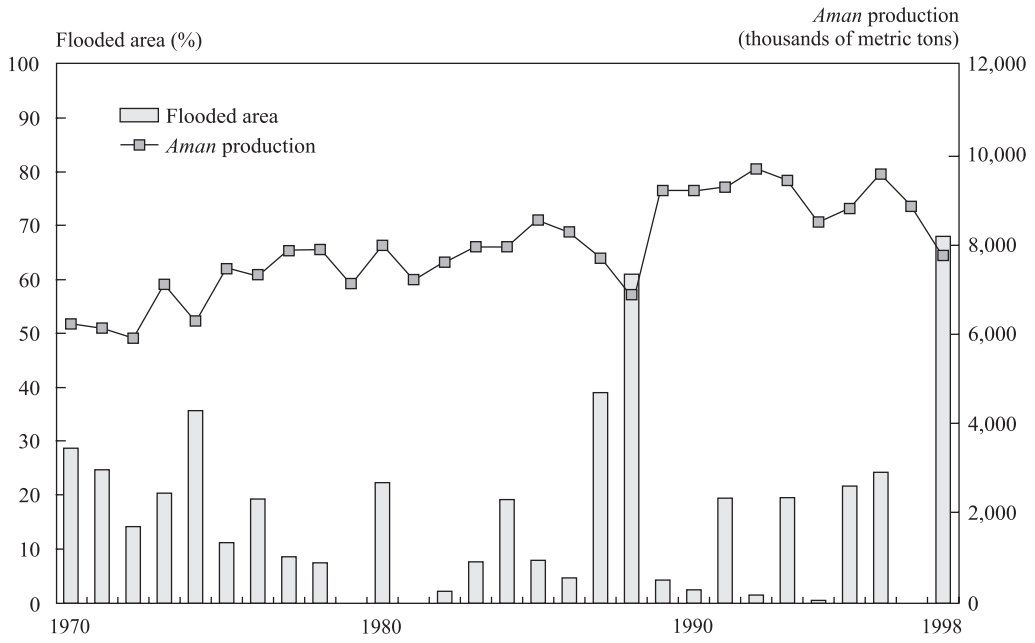
Note: Names of rivers are shown in parentheses next to station names.

Official estimates of other losses and damage in the 1988 and 1998 floods are presented in Table 1.3. The sudden rise in water levels in 1988 and the serious flooding within the city of Dhaka may account for the higher number of deaths attributed to the flood in that year and the greater reported damage to houses and schools. Nonetheless, the damage to physical infrastructure (roads, embankments, bridges, and culverts) appears to have been greater in 1998. These comparisons should be treated with caution, however, because of possible differences in definitions and data coverage.

[5] Bangladesh Water Development Board (1998: 28, 29).

[6] Irrigation Support Project for Asia and the Near East (1993: 1).

Figure 1.1 Flooded area and *aman* production, 1970–98



Source: Bangladesh Water Development Board 1998 and Food Planning and Monitoring Unit.

Outline of the Report

The rest of this report examines the impacts of the 1998 floods on food security at the national and household levels, the response of government and markets, and household coping strategies. Chapter 2 outlines the conceptual framework used in the analysis at both the sectoral and micro levels. Here we also discuss the sampling frame and the basic household characteristics in the survey of rural households in flood-affected regions. Chapter 3 describes foodgrain markets, availability, and government policy interventions during the floods, highlighting the important role of private sector imports in stabilizing prices and maintaining the availability of rice and wheat.

The next two chapters focus on the assessment of the impact of the floods on households. Chapter 4 presents data on various measures of the immediate effects of the floods on incomes and earnings, looking in particular at losses of agricultural production, losses of assets, and reduction in labor market participation and earnings. Chapter 5 presents a detailed analysis of the impact of the floods on food consumption and food security, gender discrimination, illness, and the nutritional status of children and women.

Chapter 6 covers household coping strategies. It begins with a description of the main coping strategies used by households, as reported during rapid appraisals. Then the key

Table 1.3 Estimates of losses and damage in the Bangladesh floods of 1988 and 1998

	1988	1998
Area flooded (km^2)	89,970	100,250
Average duration of floods (days)	34	59
Number of affected people	45,000,000	30,916,351
Number of deaths	2,379	918
Rice production lost (million tons)	2.00	2.04
Number of cattle lost	172,000[a]	26,564
Roads damaged (km)	13,000	15,927
Embankments damaged (km)	1,990	4,528
Number of bridges and culverts damaged	1,160	6,890
Number of affected houses	7,200,000	980,571
Number of schools damaged	19,000	1,718
Number of displaced people	n.a.	1,049,525

Sources: Grameen Trust flood website: hhtp://www.bangladeshonline.com/gob/flood98/foreign_1.html, cited in Ahmed 1999: 151. Average days of flooding from Table 1.2. Number of affected people in the 1988 flood from Irrigation Support Project for Asia and the Near East 1993.

[a] Includes goats and other non-poultry animals.

coping strategies—borrowing and purchases of food on credit, changes in eating behavior, and sales of assets—are discussed and the factors determining the choice of coping strategies are analyzed.

Chapter 7 examines the impact of major government and NGO interventions on household incomes and food consumption. The chapter highlights the impacts of food and cash transfers, examining the extent to which they were targeted to the poor and flood-affected households and their contribution to total incomes and expenditures. Finally, Chapter 8 summarizes the findings presented in earlier chapters and presents policy implications.

CHAPTER 2

Data and Methods

The 1998 floods in Bangladesh, and government policy interventions in response to the floods, affected markets and households through numerous channels. Entire communities and markets experienced damage to infrastructure and disruption of local economies. Yet this large aggregate shock also affected individuals or households in slightly different ways, depending on the exact location of their houses and fields, their occupations, and other household characteristics. As such, the floods had some of the characteristics of an idiosyncratic shock.[7]

This chapter begins with the conceptual framework used in this study, which elucidates these linkages between the floods, government policy, labor and commodity markets, household incomes and consumption, and nutrition and health outcomes. We describe the micro-level data collection and sampling frame used for the analysis at the household and individual level. Finally, we discuss two major issues important for the micro-level analysis in subsequent chapters: the definition of flood exposure and the extent to which flood exposure is correlated with poverty.

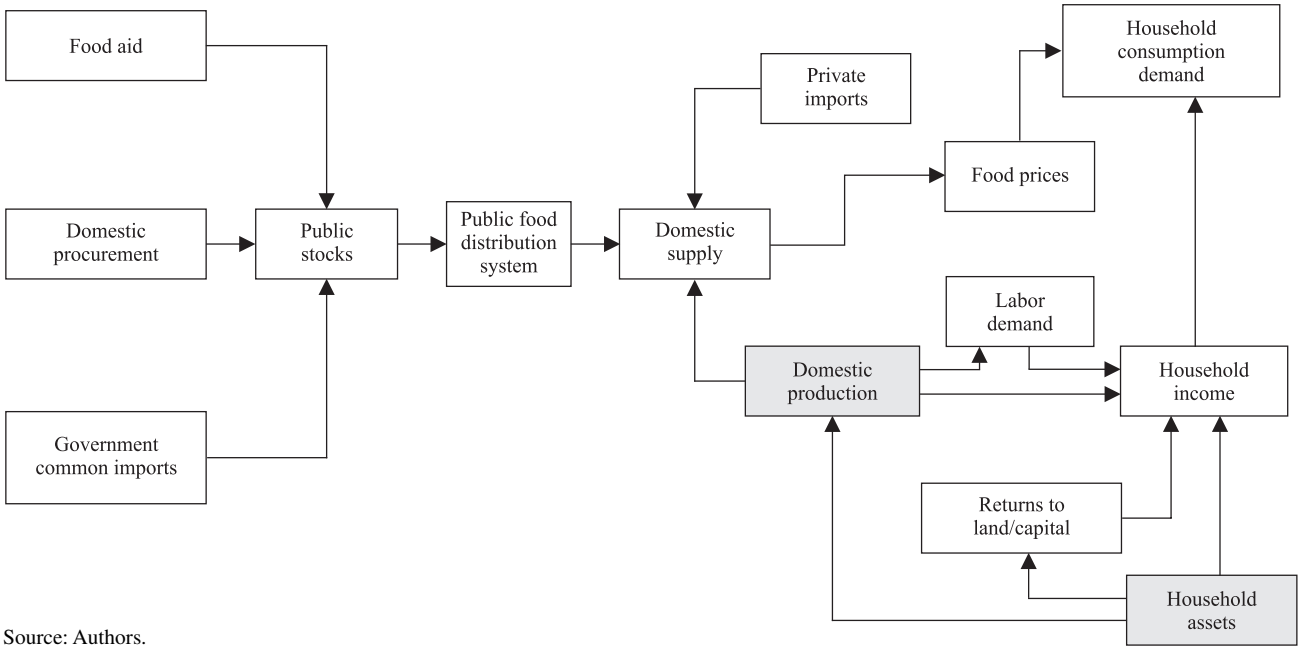
Conceptual Framework

Figure 2.1 describes the relationship between production, markets, and household consumption demand for foodgrains. As shown, the availability of foodgrains in the market is determined by the level of domestic food production, the level of private imports, and the distribution of food aid through the public food distribution system (PFDS). The distribution of the PFDS, in turn, is determined by the availability of public stocks at that time, which are themselves a result of past government procurement, government imports, and food aid in the form of current and emergency aid. The floods caused major losses of domestic production and households assets. As a result, food prices rose and the demand for labor fell, lowering household incomes and ultimately household consumption.

Figure 2.2, which draws on the United Nations International Children Fund's (UNICEF 1990) framework for the causes of malnutrition, shows how the use and allocation of labor and other household resources affect household income and expenditure and ultimately people's well-being. The allocation and level of expenditure, together with the level of prices

[7] For a review of the literature on shocks and poverty, see World Bank (2000).

Figure 2.1 The pathways of flood impact on the domestic availability and household consumption of foodgrains



Source: Authors.

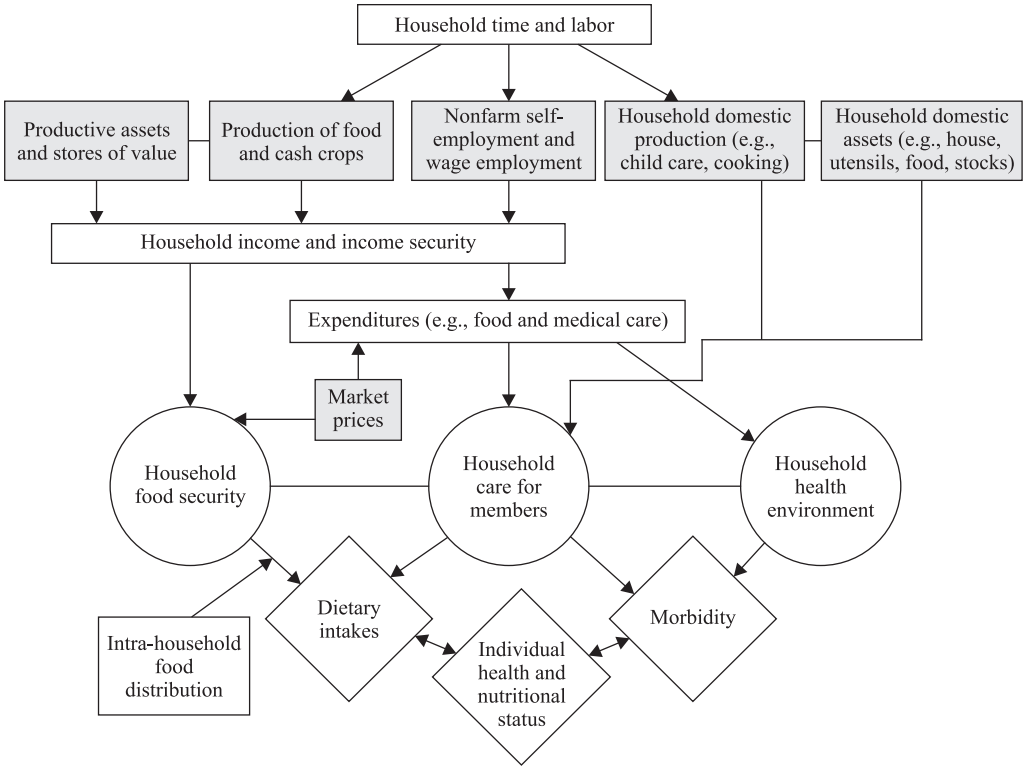
and level of care and health environment, determine the level of food security and ultimately the level of health and nutritional status. In particular, Figure 2.2 shows the many pathways through which floods, over which people have little or no control, can affect people's lives. In this case the floods had a direct impact on the endowment and the activities of the household, which affect household behavior, food security, and individual health and nutritional status in several ways.

First, the floods damaged or destroyed infrastructure, workplaces, and household assets, and disrupted the normal functioning of labor, credit, and commodity markets. Landowning farming households were particularly affected because the floodwaters damaged standing crops and receded only in late September, thus reducing the time available for planting another crop and reducing the level of own food production. Nonfarming households were also affected, because the floods destroyed the productive assets of self-employed households, such as weaving looms and rickshaws. Moreover, market disruptions caused shortages of critical recurrent inputs (for example, seeds and seedlings) to both farm and nonfarm production activities.

The reduction in agricultural production and the slowing down of the economy greatly affected the demand for labor, thus reducing the income-earning opportunities of household members. Long-term income (or livelihood) security was compromised by direct destruction or loss of assets that are stores of value. It was further jeopardized by depletions of savings or increased indebtedness, used as a coping strategy in response to short-term income losses.

The floods were also accompanied by reduced availability of food and other commodities. This led to higher prices and a reduction in the amounts that could be purchased by households. At the same time, expenditures on items critical to the proper care of household members, such as clothing or medicines, may have also been smaller than needed. Thus, food security was compromised by reduced expenditures on food resulting from additional constraints on household budgets and rising food prices.

Figure 2.2 The multiple pathways of flood impacts on household resources and people's well-being



Source: Adapted from UNICEF 1990.

Finally, the health environment was greatly disrupted. Water-borne diseases were more prevalent because of contact with contaminated floodwaters and a lack of proper sanitation facilities. Moreover, health infrastructures were by and large not available. At the same time, the floods led to direct damage to and destruction of households' domestic assets. The most important of these were their homes, which were either damaged or not habitable during the period of the floods. Other assets included water pumps necessary for accessing clean water, toilet facilities, clothing, cooking equipment, eating utensils, and food stocks. These factors, together with a reduction in the availability of fuel for cooking, disrupted domestic production (for example, childcare, meal preparation, and house cleaning), which directly affected the quality of care for household members and the quality of households' health environments.

When food security and the quality of care for household members are jeopardized, dietary intakes decline and illness increases, ultimately compromising household members' nutritional status. In dire situations, food scarcities may lead households to increase discrimination in food consumption against some of their members in order to ensure the survival of others. In short, with floods come multiple, simultaneous shocks to households' economic resources and their daily living environments. Poor households in Bangladesh faced difficult tradeoffs in deciding how to cope with the immediate losses and the deterioration in members' physical well-being because the necessary resources were undermined.

Data Collection Methodology and Sampling Frame

The micro-level analysis of this report is based mostly on The International Food

Table 2.1 List of *thanas* in the sample

	Nonpoor *thanas*	Poor *thanas*	Total
Severely affected	Muladi, Barisal District (Barisal)	Mohammadpur, Magura District (Khulna)[BINP]	—
	Shibpur, Narsingdi District (Dhaka)[BINP]	Saturia, Manikganj District (Dhaka)[Micro]	4
Moderately affected	Shahrasti, Chandpur District (Chittagong)[BINP]	Madaripur, Madaripur District (Dhaka)[BINP]	—
		Derai, Sunamganj District (Sylhet)[HKI]	3
Total	3	4	7

Source: Authors' calculations based on the 1998 Household Expenditure Survey (BBS 1998) and Bangladesh Water Development Board (BWDB 1998).

Notes: "BINP" superscript denotes *thanas* with Bangladesh Integrated Nutrition Project; "Micro" superscript denotes *thanas* where the International Food Policy Research Institute micro-nutrients survey took place; "HKI" superscript denotes *thanas* used in the Helen Keller International Nutritional Surveillance Survey.

Policy Research Institute's Food Management and Research Support Project (IFPRI-FMRSP) Household Survey 1998, a detailed survey of 757 households in seven flood-affected *thanas* in Bangladesh. Since the purpose of the study is to analyze the impact of the floods on food security and households' resulting coping strategies, we selected areas that would give a fair representation of the parts of the country affected by flooding. We used three main criteria to select the seven *thanas.* Our first criterion was the severity of flooding, as determined by the Bangladesh Water Development Board. It classified *thanas* as "not affected," "moderately affected," and "severely affected," depending on the level and depth of the floodwater. Our second criterion was the level of poverty in the district in which the *thanas* were located. *Thanas* with more than 70 percent of the population below the poverty line were classified as poor. Finally, from the *thanas* selected on the first two criteria, we chose those that had been included in other studies and that would give us a good regional and geographical balance across the six administrative divisions of Bangladesh (see Table 2.1 and Figure 2.3).

We randomly selected households using a multiple-stage probability sampling technique.[8] In the first stage, three unions in each *thana* were selected. In the second stage, six villages were selected from each union with probability proportional to the population in each village. Then, in each village two clusters (*paras*) were selected using preassigned random numbers. Finally, three households were chosen from all the households in each cluster using a systematic random selection process. As a result, we selected approximately 6 households per village (36 per union, 108 per *thana*) for a final sample size of 757 households in 126 villages.

We used three different instruments. A community questionnaire was used to collect information at the union level during the floods. A village-level survey conducted during November and December 1998 in 64 villages collected information on rural labor markets. A detailed household questionnaire, administered between the third week in November and the third week in December, sought information on the pattern of household expenditures, the pattern of land use by plot, participation in the rural labor market, ownership and loss of assets, borrowing strategy, and anthropometry. Several sections in the questionnaire contained retrospective questions on the situation during and before the floods.

It is important to point out that, even though we concentrated our analysis on the area of Bangladesh affected by the floods, there were significant differences both between and within the *thanas* surveyed, and in terms of both the level of exposure to the floods and the level of economic activity.

[8] In Saturia *thana* this was not done because we were using the random sample used by another IFPRI study.

Figure 2.3 Map of flood-affected areas of Bangladesh as of September 9, 1998, and *thanas* selected for the investigation

Source: Map of flood-affected areas prepared by GIS Unit from Flood Forecasting and Warning Centre (FFWC) and Bangladesh Water Development Board (BWDB).

Notes: Number of districts affected, 49; number of *thanas* affected, 290 (65 with normal flooding, 96 with moderate flooding, 129 with severe flooding).

Table 2.2 Construction of the flood exposure index

	Original variable		Created category variable	
Variable	**Range**	**Unit of measure**	**Range**	**Categories**
Depth of water in the homestead	0–12	Feet	0–5	0 to 4: number of feet 5: more than 4 feet
Depth of water in the home	0–45	Feet	0–6	0 to 5: number of feet 6: more than 5 feet
Number of days of water in the home	0–120	Days	0–5	0: None 1: > 0 ≤ 1 week 2: > 1 ≤ 2 weeks 3: > 2 weeks ≤ 1 month 4: > 1 month ≤ 2 months 5: > 2 months
Index			0–16	
Flood-exposed categories			0	Not exposed
			1–5	Moderate
			6–10	Severe
			11–16	Very severe

Source: IFPRI-FMRSP, Household Survey 1998.

Definition of Flood Exposure

In Bangladesh, the extent and the severity of floods are generally measured in terms of the height of water above danger level at various points on major rivers and in terms of the duration of flooding (see Chapter 1). The amount of damage to roads, submersion of highways, and losses to agricultural output are also general clues to the severity of the flooding. These measures of aggregate shocks provide an important indication of the environment in which people lived and the hardships they experienced. These regional and community-level measures are relatively easy to collect in a timely fashion and are useful for immediate relief efforts.[9]

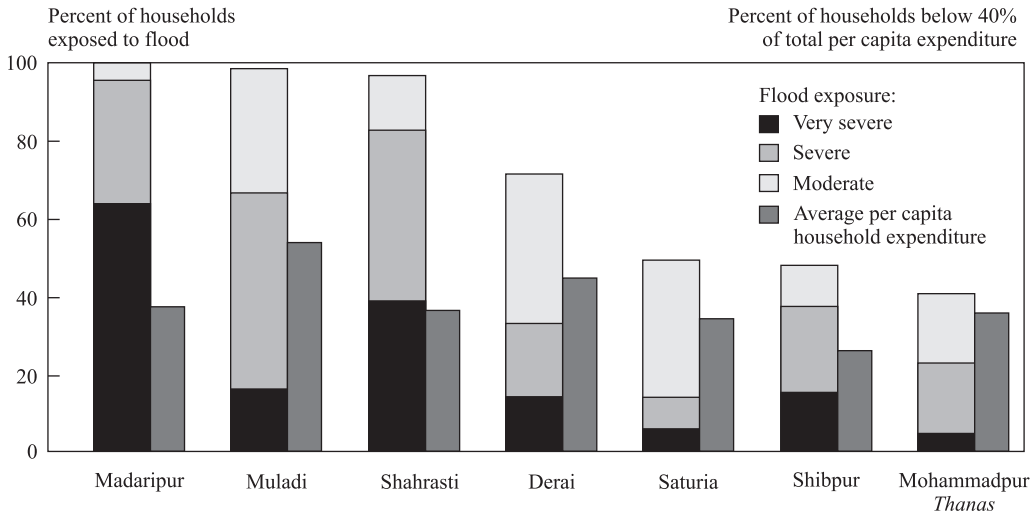
However, not all households within a given geographical area were exposed to floods to the same extent. During the 1998 floods, some households had a large amount of water on their homestead and in their homes, and some had to abandon their houses for days or weeks at the peak of the flooding. This direct exposure often depended on the height of the homestead and the presence of an embankment or a road that kept the water away.

In order to assess the degree of direct exposure to the flood at the household level we developed a simple index using information provided by the household on three measures: the depth of water in the homestead, the depth of water in the home, and the number of days water was in the house. First, for each of those measures, we created an index ranging from 0 to 5 (or 0 to 6). These indices were then summed to form a combined index, ranging from 0 to 16.[10] Finally, based on the combined index, we created a category variable in which households are classified as: (1) not exposed to the flood, (2) moderately exposed to the flood, (3) severely exposed

[9] See the rapid appraisal analysis by del Ninno and Roy (1999a).

[10] We recognize that the household flood exposure level used here may incompletely measure the effects of the flooding on crop production. This might be of particular relevance for better-off agricultural producing households with more land, but is less likely to be an issue for comparisons across villages, because village-level flood exposure is likely to be associated with field and household damage. In any case, we constructed a village-level agricultural field flood exposure variable by taking the village median of the average difference in flood depth between a normal year and the 1998 flood year, weighted by the size of the plots. We added this variable to the models to determine the level of per capita expenditure; we found that the coefficients of this variable are small and not significant, that is, the village-level agricultural field flood exposure variable does not provide any additional explanation of the determination of per capita expenditure.

Figure 2.4 Severity of flood exposure and percentage of households in the bottom 40th percentile of per capita expenditure by *thana*



Source: IFPRI-FMRSP, Household Survey 1998.

to the flood, or (4) very severely exposed to the flood. A summary of the variables used is reported in Table 2.2. Frequency distributions of these variables and of the three single indices and the combined index are presented in Appendix A.

In addition to this measure of household flood exposure we calculated a village-level variable of flood exposure. This variable, calculated as the village-level median of individual household flood exposure, is used mainly in the econometric analysis to take into account village-level unobservable characteristics related to the flood, that is, the effects of village-level flood exposure.

The resulting frequency distribution of household-level flood exposure by *thana* is reported in Figure 2.4 and Table 2.3. These show wide differences across households within *thanas* in the severity of flood exposure as well as large variations across *thanas.* All together about 50 percent of households were exposed severely or very severely to the flood, while 29 percent were not exposed directly to the flood.

Three *thanas* in the sample were particularly severely affected: Madaripur, Muladi,

Table 2.3 Household per capita expenditure by *thana* and severity of household flood exposure

					Flood exposure				
Thana	District	Per capita expenditure (Tk/month)	Bottom 40th percentile (%)	Not exposed (%)	Moderate (%)	Severe (%)	Very severe (%)	All (%)	Number
Madaripur	Madaripur	819.6	38.9	0.0	5.6	31.5	63.0	100	108
Muladi	Barisal	633.6	56.5	1.9	32.4	50.0	15.7	100	108
Shahrasti	Chandpur	809.2	38.0	4.6	13.9	43.5	38.0	100	108
Derai	Sunamganj	716.7	47.2	29.6	38.0	18.5	13.9	100	108
Saturia	Manikganj	758.4	35.8	51.4	34.9	8.3	5.5	100	109
Shibpur	Narsingdi	807.2	26.9	52.8	10.2	22.2	14.8	100	108
Mohammadpur	Magura	769.5	37.0	60.2	17.6	17.6	4.6	100	108
Total		759.1	40.0	28.7	21.8	27.3	22.2	100	757

Source: IFPRI-FMRSP, Household Survey 1998.

and Shahrasti, where 95 percent, 66 percent, and 82 percent of households, respectively, were exposed severely and very severely to the flood. The relative severity of flood exposure across *thanas,* unions, and villages as measured here corresponds with the findings and observations made at the time of the household survey, as well as with the results of a village-level rapid appraisal (del Ninno and Roy 1999a).

Flood Exposure and Poverty

Before we begin the analysis of the impact of the floods it is important to establish whether the relatively poor areas covered by the survey were exposed to the floods more than richer areas. It is also important to establish whether relatively poor *households* were exposed more than richer households. This is important because in our analysis we do not want to confound the impact of the floods with the effects of initial endowments and level of income. In other words, we want to make sure that flood exposure was a true exogenous shock for each of the households, independently of their initial economic status.

Even though some villages, some unions, and some *thanas* were exposed more than others to the floods, those areas do not appear to be poorer than the other areas. Looking at the average per capita expenditure by *thana,* reported in Table 2.3, and the percentages of households below the 40th percentile of total per capita expenditure reported in Figure 2.4, we cannot detect any association between flood exposure and poverty at *thana* level. However, since we are observing per capita expenditures after the floods, the possibility remains that these observed per capita expenditures were affected by the floods in the preceding months.

The best way to assess if poor households were exposed more than richer households would be to directly compare their expenditures before and after the floods. Unfortunately, complete data on per capita expenditures before the floods were not collected because this would have involved a recall period of five or more months.[11] Some variables that can indicate households' long-term wealth and the level of asset ownership before the floods are available, however.

Table 2.4 shows the level of pre-flood ownership of several types of assets by level of exposure to the floods.[12] Though, in general, the total value of assets owned did not vary by flood exposure, the percentage of households severely exposed to the flood was higher for those with little (less than 0.20 hectares) or no land (less than 0.02 hectares).

To check the hypothesis that there is a correlation between level of household flood exposure and household endowment (including land), we ran several regression models in which flood exposure is a function of long-term wealth, assumed to be determined by household composition, education, and pre-flood value of assets. The first two equations are Ordinary Least Squares (OLS) regressions, in which we control for a possible correlation between unobservable characteristics at the village level and the other specified independent variables using both random effects and fixed effects models (Table 2.5).[13] We also used the same explanatory variables in logit regressions to

[11] The survey was undertaken in November and December 1998, five months after the flood began in some parts of the country in July 1998.

[12] Pre-flood asset values were calculated using the value of assets that households would have owned if the floods had not occurred. In particular we used two sources of information:

1. The value of the assets owned in November–December 1998 and the percentage of the value lost owing to the floods. This is a valid method for large assets that were not sold or consumed in the period of the floods.
2. The number and value of assets lost, sold, and consumed since July 15, 1998—at the beginning of the flood. This measure is better for smaller assets that might have been sold as a coping strategy by the household to deal with the consequences of the floods.

[13] Random and fixed effects models are common ways to address the role of unobservable heterogeneity in subgroups of the data (in this instance, unobservable factors that are common within villages in the sample). Writing the estimated equation in simplified form, we have:

$$Y(h,v) = a + bX(h,v) + cF(h,v) + e(h,v)$$

Table 2.4 Availability of land and other assets in the period before the floods, by severity of flood exposure

		Flood exposure			
	Not exposed	Moderate	Severe	Very severe	All
Landless					
Percentage of households < 0.02 hectares	46.1	49.1	46.9	54.8	48.9
Percentage of households < 0.20 hectares	69.1	66.1	65.2	72.6	68.2
Land (total)					
Percentage of households owning land	56.7	53.3	54.1	47.6	53.2
Average size of land (hectares)	0.45	0.86	0.43	0.40	0.53
Average value of land (Tk)	275,824	310,599	265,728	213,150	268,170
House assets					
Percentage of households	100.0	97.6	97.1	98.8	98.4
Mean value (Tk)	23,863	31,668	24,884	23,368	25,715
Productive assets					
Percentage of households	92.6	93.9	93.2	94.1	93.4
Mean value (Tk)	6,971	7,893	6,800	6,639	7,052
Domestic assets					
Percentage of households	97.2	95.2	96.6	97.0	96.6
Mean value (Tk)	3,713	2,747	2,271	2,225	2,779
Consumer durables					
Percentage of households	34.6	37.0	29.5	22.6	31.0
Mean value (Tk)	2,630	3,652	1,368	1,867	2,444
Liquid assets					
Percentage of households	73.3	66.7	77.8	66.1	71.5
Mean value (Tk)	9,955	13,570	9,262	10,127	10,519
Other assets					
Percentage of households	11.1	9.1	12.1	16.7	12.2
Mean value (Tk)	2,378	2,220	994	957	1,544
Livestock					
Percentage of households owning cattle	53.9	48.5	48.8	42.3	48.8
Mean value (Tk)	8,371	9,093	8,633	8,427	8,610
Percentage of households owning chickens	76.5	77.6	83.1	85.7	80.6
Mean value (Tk)	348	388	454	456	412
Mean value of all assets (Tk)	42,396	52,315	40,426	38,934	43,251
Number of households	217	165	207	168	757

Source: IFPRI-FMRSP, Household Survey 1998.

determine the probability of a household being exposed to the flood (Table 2.6).

In the OLS fixed and random effects models in which the dependent variable is the index of the level of exposure to the flood (0–16), land has a positive and significant correlation with level of flood exposure (Table 2.5). In the logit models, in which we are looking only at the difference between flood and non-flood exposed households, the correlation is not significant and the odds ratio is practically equal to 1 (Table 2.6). Moreover, even in the OLS fixed and random effects regressions, the impact of land ownership on household flood exposure is not very large. The difference in predicted

where $e(h,v) = n(v) + u(h)$, for households, h, and village, v. In the random effects specification, the error term, $n(v)$ is modeled as a random variable that is uncorrelated with the other right-hand-side variables. Estimation of this model is done using Generalized Least Squares (GLS). In the fixed effects specification, it is assumed that the unobservable village-level characteristics, $n(v)$, may be correlated with the flood, $F(h,v)$ (and possibly other exogenous variables, $X(h,v)$). In this case we express each variable in the regression as the difference between the observed variable and its village-level mean value, so the fixed effects estimation measures only the effects of the right-hand-side variables to the extent that they are different from their village mean values. Thus, the fixed effects model essentially gives a comparison across households within the same village, whereas the random effects model combines within and across village effects. A basic description of the models used and the tests performed is available in Greene (1997: 443–444), Judge et al. (1985: 527), and Hausman (1978).

Table 2.5 Determinants of household flood exposure: Regression results (dependent variable: flood index 0–16)

	OLS with village random effect		OLS with village fixed effect	
Description	**Coefficient**	***t*-statistic**	**Coefficient**	***t*-statistic**
Female-headed household	–0.0916	–0.15	0.0292	0.05
Age of household head	0.0104	0.73	0.0108	0.76
Proportion males: 0–4 years	0.0043	0.26	0.0064	0.39
Proportion males: 5–14 years	0.0255	1.63	0.0286	1.83*
Proportion males: 15–19 years	0.0072	0.39	0.0085	0.46
Proportion males: 20–34 years	0.0014	0.09	0.0058	0.35
Proportion males: 35–54 years	0.0231	1.51	0.0260	1.71*
Proportion females: 0–4 years	0.0073	0.46	0.0042	0.27
Proportion females: 5–14 years	0.0113	0.79	0.0113	0.79
Proportion females:15–19 years	–0.0027	–0.15	–0.0019	–0.11
Proportion females: 20–34 years	–0.0128	–0.86	–0.0124	–0.84
Proportion females: 35–54 years	–0.0200	–1.42	–0.0167	–1.19
Household size	–0.0621	–0.34	–0.1182	–0.65
Number of males: Any primary education	–0.1705	–1.14	–0.1797	–1.20
Number of males: Any secondary education	0.0498	0.22	0.0210	0.09
Number of females: No education	0.0022	0.01	0.0661	0.20
Number of females: Any primary education	–0.0978	–0.29	–0.0965	–0.29
Number of females: Any secondary education	0.3136	0.78	0.3645	0.91
Pre-flood value of land (Tk thousands)	–0.0120	–2.15*	–0.0136	–2.43*
Productive asset value (Tk thousands)	0.1119	0.92	0.1103	0.91
Liquid asset value (Tk thousands)	–0.0139	–0.41	–0.0234	–0.69
Housing asset value (Tk thousands)	0.0010	0.03	0.0002	0.01
Domestic asset value (Tk thousands)	0.0553	0.13	0.4924	1.17
Other assets value (Tk thousands)	–1.4218	–1.36	–1.3406	–1.28
Credit before1998 (dummy variable)	–0.1989	–0.49	–0.0748	–0.18
Constant	5.4998	4.30*	5.2820	4.27*
Number of observations	753		753	
Number of villages	117		117	
R^2	.02		.01	
Random effects versus fixed effects (*p*-value)**	.01			

Source: IFPRI-FMRSP, Household Survey 1998 and authors' calculations.

* denotes that the coefficient is statistically significant at the 10% level or less. ** values for random versus fixed effects are the result of the Hausman test.

flood exposure between a household with no land assets and a household with the largest land assets is only 3 points on the 0–16 scale. In the context of rural Bangladesh this result can be explained by the fact that households that have more land have the possibility of building their house on slightly higher ground than households without any land. This does not mean that they were not exposed to the flood, just that they were not as severely exposed as households with less land.

The main conclusion from the regression results in Tables 2.5 and 2.6, however, is that pre-flood determinants of wealth do not explain variations in flood exposure across households in the sample. Based on these results, we use the flood exposure variable in the following analysis as an independent variable to explain the impact of the floods on a series of individual- and household-level outcomes, such as the level of caloric consumption, food security, and other health and nutrition outcomes.

In most of our analysis, we use the OLS fixed and random effects models to examine the impact of the floods on individual- and household-level outcomes. These models capture the impact of the level of flood ex-

Table 2.6 Determinants of household flood exposure: Regression results (dependent variable: household flood exposure (0 or 1))

	Logit with village random effect		Logit with village fixed effect	
Description	**Odds ratio**	***z*-statistic**	**Odds ratio**	***z*-statistic**
Female-headed household	1.19	0.25	1.86	0.81
Age of household head	0.95	–2.64*	0.96	–2.05*
Proportion males: 0–4 years	0.97	–1.14	0.97	–1.20
Proportion males: 5–14 years	0.99	–0.32	1.00	–0.14
Proportion males: 15–19 years	1.00	–0.19	1.00	0.00
Proportion males: 20–34 years	0.99	–0.64	0.99	–0.35
Proportion males: 35–54 years	1.03	1.56	1.04	1.65*
Proportion females: 0–4 years	0.98	–1.08	0.99	–0.64
Proportion females: 5–14years	0.97	–1.90	0.97	–1.42
Proportion females:15–19 years	0.96	–1.83*	0.98	–1.03
Proportion females: 20–34 years	0.95	–2.93*	0.96	–2.00*
Proportion females: 35–54 years	0.95	–2.92*	0.96	–2.08*
Household size	1.09	0.34	1.11	0.43
Number of males: Any primary education	0.71	–1.64*	0.64	–1.92*
Number of males: Any secondary education	1.48	1.23	1.40	1.02
Number of females: No education	1.35	0.69	1.17	0.38
Number of females: Any primary education	1.11	0.23	0.97	–0.06
Number of females: Any secondary education	3.67	2.15*	2.93	1.74*
Pre-flood value of land (Tk thousands)	0.99	–1.72*	0.99	–1.18
Productive asset value (Tk thousands)	0.90	–0.57	0.76	–1.11
Liquid asset value (Tk thousands)	0.98	–0.29	0.83	–0.88
Housing asset value (Tk thousands)	1.06	1.04	1.04	0.68
Domestic asset value (Tk thousands)	0.67	–0.77	0.96	–0.07
Other assets value (Tk thousands)	0.07	–1.84*	0.02	–1.49
Credit before1998 (dummy variable)	1.41	0.69	1.52	0.81
Number of observations	753		286	
Number of villages	117		40	
χ^2	36.8		37.4	
Prob χ^2	0.06		0.05	

Source: IFPRI-FMRSP, Household Survey 1998 and authors' calculations.

* denotes that the coefficient is statistically significant at the 10% level or less.

posure at the household level, taking into account unobservable village characteristics. In some cases, we also use the village flood exposure variable, capturing the direct and indirect effects of the floods common to all households within a village.

Determinants of Current Per Capita Expenditure

The above discussion argues that household exposure to floods can be treated as an exogenous variable in our analysis, since pre-flood household and village characteristics do not explain the variation in flood exposure across households. Thus, in discussing the results of the survey in subsequent chapters of this report, we will present tables comparing various outcomes of interest across households with various levels of flood exposure. Likewise, the regression analyses will treat both household-level and village-level flood exposure variables as exogenous variables.

In addition, we will compare various outcomes across per capita expenditure quintiles because of the policy relevance of the level of household incomes (expenditures). We now show that, although per capita ex-

Table 2.7 Determinants of per capita household expenditure: Regression results

			Household-level flood expenditure			
	Village-level flood exposure		With village random effect		With village fixed effect	
Description	**Coefficient**	***t*-statistic**	**Coefficient**	***t*-statistic**	**Coefficient**	***t*-statistic**
Female-headed household	–0.3679	–4.76*	–0.3752	–4.45*	–0.3933	–4.38*
Age of household head	–0.0027	–1.42	–0.0023	–1.20	–0.0012	–0.59
Proportion males: 0–4 years	–0.0059	–1.48	–0.0057	–2.46*	–0.0052	–2.15*
Proportion males: 5–14 years	–0.0044	–1.78*	–0.0048	–2.22*	–0.0055	–2.40*
Proportion males: 15–19 years	0.0008	0.27	0.0010	0.39	0.0015	0.55
Proportion males: 20–34 years	0.0025	1.01	0.0025	1.10	0.0025	1.03
Proportion males: 35–54 years	0.0017	0.83	0.0016	0.77	0.0013	0.56
Proportion females: 0–4 years	–0.0045	–2.30*	–0.0044	–2.06*	–0.0044	–1.92*
Proportion females: 5–14 years	–0.0062	–3.38*	–0.0058	–3.00*	–0.0047	–2.27*
Proportion females:15–19 years	–0.0027	–1.14	–0.0025	–1.00	–0.0019	–0.70
Proportion females: 20–34 years	0.0004	0.23	0.0008	0.37	0.0014	0.65
Proportion females: 35–54 years	0.0021	1.14	0.0020	1.02	0.0015	0.71
Household size	–0.0553	–1.49	–0.0561	–2.18*	–0.0613	–2.21*
Number of males: Any primary education	0.0042	0.23	0.0067	0.33	0.0129	0.58
Number of males: Any secondary education	0.0366	1.16	0.0374	1.19	0.0431	1.28
Number of females: No education	–0.0263	–0.48	–0.0313	–0.70	–0.0422	–0.89
Number of females: Any primary education	0.0378	0.63	0.0350	0.75	0.0257	0.52
Number of females: Any secondary education	0.1245	1.81*	0.1287	2.28*	0.1390	2.35*
Pre-flood value of land (Tk thousands)	0.0013	1.44	0.0013	1.74*	0.0012	1.48
Productive asset value (Tk thousands)	0.0442	2.37*	0.0447	2.69*	0.0467	2.60*
Liquid asset value (Tk thousands)	–0.0006	–0.13	0.0004	0.08	0.0017	0.35
Housing asset value (Tk thousands)	0.0211	4.39*	0.0201	3.87*	0.0184	3.30*
Domestic asset value (Tk thousands)	0.0507	1.04	0.0538	1.01	0.0704	1.15
Other assets value (Tk thousands)	0.3972	4.24*	0.4162	2.91*	0.4630	3.04*
Credit before1998 (dummy variable)	0.0765	1.33	0.0638	1.17	0.0284	0.48
Number of dependent workers	–0.0142	–0.49	–0.0102	–0.34	–0.0008	–0.02
Number of day laborers	–0.0633	–1.99*	–0.0661	–2.25*	–0.0761	–2.39*
Persons engaged in business	0.0116	0.34	0.0120	0.36	0.0154	0.42
Persons in own farm	0.0820	2.88*	0.0838	2.86*	0.0841	2.60*
Having electricity supply	0.1353	3.26*	0.1432	2.94*	0.1677	3.02*
Moderately flood exposed	0.0076	0.14	0.0031	0.07	0.0103	0.17
Severely flood exposed	0.0180	0.39	0.0121	0.27	0.0400	0.61
Very severely flood exposed	0.0801	1.65*	0.0414	0.88	0.0394	0.55
Constant	6.8980	41.69*	6.8944	39.52*	6.8664	36.58*
Number of observations	757		757		757	
Number of villages	117		117		117	
R^2	.37		.37		.36	
Random effects versus fixed effects (*p*-value)**					.33	

Source: IFPRI-FMRSP, Household Survey 1998 and authors' calculations.

Note: The dependent variable is the log of per capita expenditure.
* denotes that the coefficient is statistically significant at the 10% level or less. ** values for random versus fixed effects are the result of the Hausman test.

penditures are endogenous,[14] they are not determined by either the household or the village level of exposure to the floods.

To test the relationship between current per capita expenditure and long-term wealth status and the level of exposure, we used a model in which we explain the level of current per capita expenditure as a function of household characteristics (gender, age of household head, proportion of household

[14] We treat the issue of endogeneity of per capita expenditures through standard statistical techniques in the regressions, including per capita expenditures as an explanatory variable in subsequent chapters.

members in different age categories, household size, number of members with different educational levels, number of people in different occupations, and level of pre-flood assets), as well as of the level of exposure to the floods. The results, presented in Table 2.7, show that flood exposure is not a determinant of current per capita expenditure when controlling for level of pre-flood assets and other household-level characteristics. This was possible for several reasons. First, despite flood-exposed households' lower resources, they were able to maintain at least the same level of expenditure, though not the same level of consumption because of higher food prices and additional expenditure needed for things such as health and fuel. Second, as shown later, households were able to smooth their expenditure by borrowing and by purchasing food on credit. This means that the level of current per capita expenditure is a good measure of long-term economic status and can stand as a proxy of the level of poverty. Thus, it can be used to rank households from the poorest in the bottom expenditure quintile to the richest in the top quintile. Moreover, because post-flood per capita expenditure indicates both long-term economic status and the level of resources available at the end of the floods, it has relevance for targeting flood relief and transfers.

Summary

The theoretical framework presented in this chapter outlines the pathways by which the 1998 floods affected markets, households, and individuals. Particularly important are the pathways emanating from the loss of agricultural production, reductions in employment opportunities, and the loss of assets, which caused major reductions in household incomes and wealth.

The micro-level data set used in the empirical analysis of the impact of the floods on household welfare derives from a household survey in November and December 1998 that covered 757 rural households in seven flood-exposed *thanas* in Bangladesh. At the household level, flood exposure was based on the depth of water in the homestead, the depth of water in the house, and the number of days water was in the house.

Ideally, to examine the impact of the floods, a panel data set with information on household incomes and expenditures both before and after the floods would be used. However, since pre-flood income and expenditure data are unavailable, it is important to disentangle the effects of pre-flood wealth and incomes from the impacts of the floods. The regression analysis presented in Tables 2.5 and 2.6 indicates that pre-flood determinants of wealth do not explain variations in flood exposure across households in the sample. Based on these results, we use the flood exposure variable in the following analysis as an independent variable to explain the impact of the floods on a series of individual- and household-level outcomes, such as the level of caloric consumption, food security, and other health and nutrition outcomes.

Finally, the regression analysis presented in Table 2.7 indicates that flood exposure is not a statistically significant determinant of post-flood household expenditures; in other words, the floods were a true random shock that affected households independent of their level of wealth. Thus, we can use the level of current per capita expenditure as a measure of long-term economic status.

CHAPTER 3

Foodgrain Markets and Availability

The 1998 floods in Bangladesh were a major threat to national food security in Bangladesh, not because of the initial damage to standing crops, but because of potential damage to the major monsoon season rice crop and rural incomes. This chapter focuses on the behavior of foodgrain (rice and wheat) availability during and after the floods. We begin with an overview of the importance of rice and wheat in national food availability in Bangladesh and the roles of the private and public sectors in foodgrain marketing. Turning to the markets and government policy at the time of the floods, we discuss initial food relief efforts, including the contribution of food aid. We then focus on rice and wheat markets following the floods, highlighting the massive private sector imports from India. We follow this with an analysis of the contribution of private sector imports to food security at the national level in Bangladesh, discussing alternative estimates of the volume of trade, the structure of the market, and alternative sources of supply. The chapter concludes with a comparison of government policies and market behavior in 1998 with those following earlier large production shortfalls owing to floods in 1974 and 1988.

Domestic Foodgrain Production and Markets

Domestic Foodgrain Production

Rice dominates agricultural production and food consumption in Bangladesh, accounting for 58.3 percent of value-added in agriculture (9.1 percent of total GDP) and 72.8 percent of calories consumed in 1998.[15] Over the 1980s and 1990s, domestic rice production slightly outpaced population growth (2.0 versus 1.9 percent per year), enabling annual per capita rice availability to increase from 137.1 kilograms in the 1980s to 144.2 kilograms in the 1990–99 period while annual average rice imports declined from 308,000 tons to 160,000 tons (Table 3.1). In contrast, per capita wheat availability has declined despite sharp increases in wheat production (from 112,000 tons at Independence in 1971 to 1.91 million tons in 1999), because of lower levels of food aid.

[15] Unpublished 1997/98 national accounts data (in current prices) from the Bangladesh Bureau of Statistics (BBS) and Food and Agriculture Organization, *Food balance sheet,* various issues.

Table 3.1 Foodgrain availability and requirements in Bangladesh, 1980/81 to 1999/2000

Year	Rice production	Net PFDS distribution	Private imports	Net rice availability	Per capita rice availability (kg/capita)	Wheat production	Net PFDS distribution	Private imports	Net wheat availability	Net foodgrain availability	Per capita wheat availability (kg/capita)	Per capita foodgrain availability (kg/capita)	Food aid (total foodgrain)	Government commercial imports
1980/81	13,880	–327	0	12,165	135.3	1,092	852	0	1,835	14,000	20.4	155.7	751	325
1981/82	13,629	482	0	12,748	138.7	967	1,282	0	2,153	14,901	23.4	162.1	1,141	114
1982/83	14,215	328	0	13,121	139.7	1,095	1,415	0	2,401	15,522	25.6	165.3	976	868
1983/84	14,509	358	0	13,416	139.7	1,211	1,427	0	2,517	15,933	26.2	166.0	1,441	615
1984/85	14,623	266	0	13,426	136.9	1,464	1,948	0	3,265	16,692	33.3	170.1	1,306	1,287
1985/86	15,038	153	0	13,687	136.5	1,042	1,039	0	1,977	15,664	19.7	156.2	1,087	113
1986/87	15,406	358	0	14,223	138.8	1,091	1,574	0	2,555	16,779	24.9	163.7	1,425	342
1987/88	15,413	180	0	14,052	134.2	1,048	1,948	0	2,891	16,943	27.6	161.8	1,787	1,130
1988/89	15,544	326	0	14,316	134.0	1,021	2,199	0	3,117	17,433	29.2	163.2	1,356	780
1989/90	17,856	–243	0	15,827	145.3	890	1,447	0	2,248	18,075	20.6	166.0	949	584
1990/91	17,852	244	0	16,311	146.9	1,004	1,345	0	2,248	18,559	20.3	167.2	1,540	37
1991/92	18,252	–180	0	16,246	143.8	1,065	1,509	0	2,468	18,714	21.8	165.6	1,414	150
1992/93	18,341	243	0	16,750	145.7	1,176	597	355	2,010	18,761	17.5	163.1	735	93
1993/94	18,041	202	74	16,512	141.1	1,131	1,008	238	2,338	18,851	20.0	161.1	654	0
1994/95	16,833	83	583	15,816	132.9	1,245	1,213	430	3,347	19,162	28.1	161.0	935	620
1995/96	17,687	240	650	16,808	138.9	1,369	1,133	200	3,215	20,023	26.6	165.5	738	839
1996/97	18,883	226	15	17,236	140.1	1,454	550	222	2,096	19,331	17.0	157.2	618	112
1997/98	18,854	130	993	18,106	144.8	1,803	875	142	2,640	20,745	21.1	166.0	549	253
1998/99	19,905	35	2,661	20,610	162.3	1,908	1,346	804	3,867	24,477	30.5	192.7	1,233	763
1999/2000	22,840	120	390	21,066	163.3	1,700	845	745	3,120	24,186	24.2	187.5	895	0
Av. 1980/81 –1988/89	14,695	236	0	13,462	137.1	1,115	1,520	0	2,524	15,985	25.6	162.7	1,252	619
Av. 1989/90 –1998/99	18,250	98	498	17,022	144.2	1,305	1,102	239	2,648	19,670	22.4	166.5	937	345

Sources: Bangladesh Bureau of Statistics, Marketing Information System (MIS), Directorate General of Food, and authors' calculations.

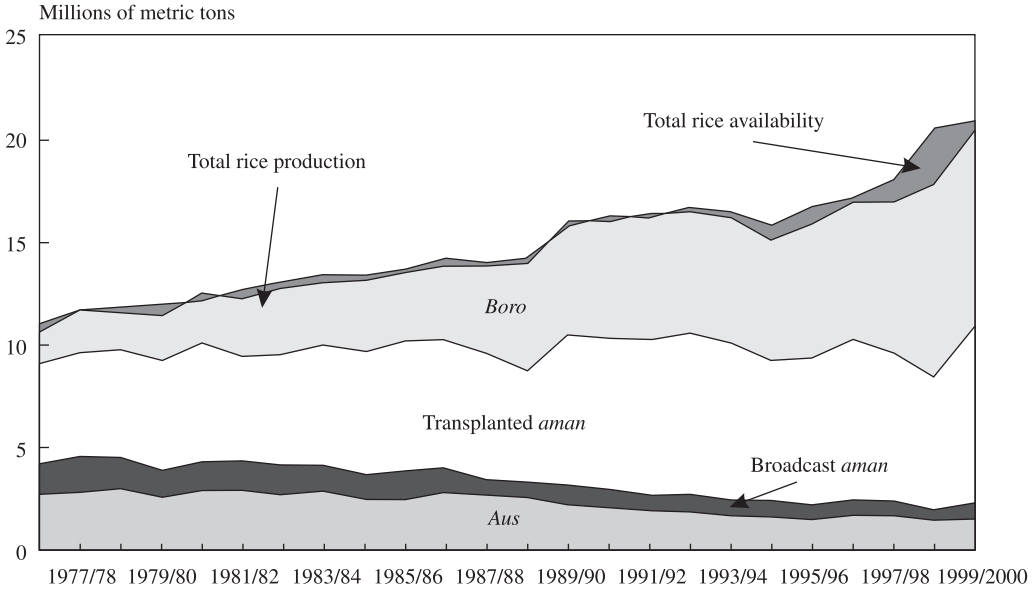
Notes: The unit of measure is thousand metric tons unless otherwise noted. Before 1985/86, per capita requirements were calculated at 15.5 oz/day. Before 1991/92, private imports of foodgrains were not allowed. The data for 1999/2000 are projected. PFDS = Public food distribution system.

Bangladesh annually produces three crops of rice: *aman,* typically transplanted in June–July and harvested in November–December, *boro,* transplanted in December–January and harvested in May–June, and *aus,* often directly sown in March–April and harvested in July–August. Depending on the extent of normal seasonal flooding and water availability through irrigation during the dry winter season, two crops of rice are often grown on the same plot of land. Wheat, which requires cold nights to produce a crop, can be grown only during the winter season in Bangladesh, and is typically sown in November–December and harvested in March–April.[16] This sustained increase in rice availability per capita has enabled a long-term decline in real rice prices, as demand growth, limited by lower per capita demand by urban households, relatively slow rural income growth, and changing tastes, has not kept up with supply (Dorosh 2000).

Most of the increase in rice production in the 1980s and 1990s was due to increases in *boro* production; *aman* production stagnated and *aus* production fell as *boro* cultivation replaced *aus* in many areas (Figure 3.1). Prior to the mid-1980s the *boro* harvest in Bangladesh was relatively small—only 20 percent of rice production in 1974. A major

[16] See Dorosh (2000) and Zohir (1995) for further discussion of cropping patterns.

Figure 3.1 Total rice production and availability in Bangladesh, 1976/77–1999/2000



Sources: Food Planning and Monitoring Unit, Ministry of Food.
Note: *Aus, aman,* and *boro* production figures are net of 10 percent seed, feed, and wastage.

expansion in *boro* production followed the liberalization of imports of diesel engines and pumps for tubewell irrigation in 1988 and the expansion in fertilizer use and planting of high-yielding varieties (HYVs) of rice (Ahmed 2000).

These changes in cropping patterns resulting from an increase in minor irrigation and the availability of modern varieties have reduced the susceptibility of Bangladesh agriculture to floods in two ways. First, the area planted to deepwater (broadcast) *aman* rice, grown on flood-prone land during the monsoon season, has declined by 58 percent, from 1.83 million hectares to 775,000 hectares between 1975/76 and 1999/2000. Because this land has been increasingly left fallow during these months and planted with irrigated *boro* rice in the dry season, the potential crop damage due to severe flooding has diminished. Second, the large expansion of the *boro* crop has greatly increased the quantity of rice produced within five to six months of a damaged rice harvest (Hossain, Bose, and Chowdhury 2001).

In fact, the most rapid expansion in *boro* cultivation took place in 1987/88 and 1988/89 after severe floods damaged *aman* rice crops, providing additional incentives for rice farmers to expand their *boro* production. *Boro* production rose by 45 percent in these two years, from 4.01 to 5.83 million tons. Thus, by the late 1980s *boro* production acted as a major automatic stabilizer to annual production following *aman* production shortfalls (Chowdhury and Haggblade 2000).

The Private and Public Sector Roles in Foodgrain Markets

Along with the growth in domestic production, the size of the domestic foodgrain markets and the role of the private sector has also increased dramatically in Bangladesh in recent decades. As rice production increased from 12 million tons per year in the 1970s to 18 million tons per year in the 1990s, the volume of rice sold rose from 3 to 9 million tons, from 27 percent to 49 percent of production (Chowdhury and Haggblade 2000). At the same time, the public share of marketing fell

by half, from 15 percent to 7 percent. Moreover, the number of marketing agents expanded dramatically as well. In the 1960s, there were only about 4,000 itinerant traders in the former East Pakistan, compared with 48,000 in Bangladesh in the 1990s. Similarly, the number of millers doubled from 6,155 in the 1960s to 11,592 in the 1970s, then increased more than fourfold by the 1990s to nearly 51,000.

The large expansion in the number of participants, the size of the market, investments in infrastructure (roads, bridges, electricity, and telecommunications), and a gradual easing of restrictions on private sector trade (including the lifting of a ban on commercial bank credit for foodgrain trade) have resulted in a well-functioning private market. Das, Zohir, and Baulch (1997) have shown that wholesale markets for both rice and wheat are spatially integrated, with over 80 percent of price changes transmitted between pairs of markets within two weeks.[17]

Though its size relative to the private market has diminished, public sector foodgrain distribution in Bangladesh plays an important role in the domestic procurement of rice and wheat, the management of food aid inflows, public sector targeted distribution, and the maintenance of emergency foodgrain stocks. Foodgrain is typically procured at fixed prices. Most government procurement is done through fixed-price purchases of grain directly from farmers or traders.[18]

Until Bangladesh instituted major reforms in the early 1990s, subsidized sales of grain through ration channels dominated foodgrain distribution. Between 1988/89 and 1990/91, on average 612,000 tons of rice and wheat were sold through the Rural Rationing and the urban Statutory Rationing channels, or 26.7 percent of total foodgrain distribution (which averaged 2.294 million tons). Total sales, including open market sales and other programs, accounted for 63.5 percent of distribution in this period, with relief and Food for Work channels accounting for the other 36.5 percent of distribution. Reforms in 1991/92 and 1992/93 closed the Rural Rationing and Statutory Rationing channels, in an effort to improve the targeting of foodgrain distribution as well as to reduce fiscal costs (Ahmed, Haggblade, and Chowdhury 2000). As a result, both the percentage and the total amount of foodgrain distributed through targeted and relief channels increased in the mid to late 1990s, averaging 1.166 million tons per year from 1995/96 to 1997/98, or 72.8 percent of the 1.603 million tons total annual average distribution during these three years.

With the increasing role of the private sector in foodgrain markets and a reduction in total public sector foodgrain distribution, government stocks were gradually reduced through most of the 1990s. From 1988/89 to 1990/91, prior to the closing of rationing channels, total stocks averaged 1.131 million tons (566,000 tons of rice and 565,000 tons of wheat). From 1995/96 to 1997/98, stocks were on average only 870,000 tons (425,000 tons of rice and 445,000 tons of wheat), a decline of 261,000 tons. At the start of July 1998, just before the floods, stocks were 630,000 tons, and rose to 711,000 tons at the start of August as *boro* procurement continued.

Food Aid and Public Foodgrain Distribution

In late August 1998, it became clear that the floods would likely lead to a very large shortfall in rice production. The floods had already caused substantial damage to existing crops, road infrastructure, and other assets. Damage to the *aus* rice crop, harvested in July and August, led to losses of 300,000 tons (16.0 percent of the initial target production,

[17] Das, Zohir, and Baulch (1998) used data from 1988 through 1996. Goletti (1994: 27–38) also presents evidence of "a moderate degree of market integration" in rice markets using data from 1989/90 to 1991/92.

[18] Local tenders have also been used in recent years, particularly when fixed-price procurement has failed to meet government targets.

Table 3.2 Estimates of the Bangladesh food gap, 1998/99 (million metric tons)

gap	*Aus*	*Aman*	*Boro*	Wheat	Gross food production	Net food production[a]	Foodgrain consumption requirement[b]	Food
Pre-flood estimate (June 1998)	1.90	9.50	7.80	1.80	21.00	18.90	21.03	2.13
Projection with flood damage to *aus* and *aman* (August 26, 1998)	1.60	8.97	7.80	1.80	20.17	18.15	21.03	2.88
Projection with increased *boro* production (mid-September 1998)	1.60	7.60	8.00	1.90	19.10	17.19	21.03	3.84
Final estimate	1.62	7.74	10.05	1.91	21.31	19.18	21.03	1.85

Sources: Bangladesh Bureau of Statistics, Food Planning and Monitoring Unit, and authors' calculations.

[a] Net food production equals gross food production less 10 percent adjustment for seed, feed, and wastage.
[b] The foodgrain consumption requirement is calculated as the target per capita foodgrain consumption (454 grams/person/day) times the population (127 million).

but only 1.4 percent of projected rice production for 1998/99).

Throughout August and September, as the extent and duration of the flooding increased, the *aman* rice crop loss estimates were adjusted upwards. With floodwaters spreading over more and more areas of the country and prospects for the December *aman* crop becoming increasingly bleak, the government of Bangladesh launched an international appeal for aid on August 26, 1998, including a request for additional food aid. Subsequently, projected *aman* production shortfalls rose from 0.53 million tons on August 26, 1998, to 1.9 million tons in mid-September, making the total projected loss in rice production 2.2 million tons.[19]

The Projected Food Gap and Food Aid Inflows

In estimating its food aid needs, the government of Bangladesh supplied donors with calculations of the projected food gap in Bangladesh, defined as the difference between net foodgrain production and a foodgrain consumption requirement (target) of 454 grams/person/day. Pre-flood levels of food aid commitments to Bangladesh had been based on a food gap of 2.13 million tons (Table 3.2). By mid-September, the projected food gap had risen to 3.84 million tons, based on a 2.2 million ton projected production shortfall (0.3 million tons *aus* and 1.9 million tons *aman*).[20] Note that these calculations made no attempt to estimate actual demand for foodgrain, which would likely have been reduced somewhat by the increase in market prices and a decline in real household income.[21]

In an effort to offset the 1.62 million ton increase in the food gap, donors pledged an extra 1.083 million tons of flood relief food aid to supplement the 596,000 tons of regular program food aid.[22] Ultimately, though, foodgrain availability in Bangladesh in 1998/99 turned out to be much larger than the food gap calculations suggested. As described below, in response to the increase in market prices, private foodgrain imports surged, largely offsetting the production losses from the *aus* and *aman* crops. Moreover, record wheat and *boro* rice harvests in March and

[19] Ultimately, the final official estimate of 1998/99 *aman* rice production was 7.74 million tons, making the shortfall in *aus* and *aman* 2.04 million tons below the pre-flood target.

[20] Later adjustments to both *aman* and *boro* production forecasts brought the projected food gap down to only 1.85 million tons.

[21] Some commentators have pointed out that the government of Bangladesh had an incentive to overestimate the flood damage to the *aus* and *aman* crops in order to get more food aid. However, as the discussion on alternative estimates of rice imports (later in this chapter) indicates, total rice production for the December 1997 to April 1999 period seems to have been overestimated rather than underestimated.

[22] Note, however, that delivery of 300,000 tons of US 416-B food aid was postponed until after the June 30 end of the 1998/99 Bangladesh fiscal year.

May/June 1999, respectively, boosted production for the fiscal year. Foodgrain from the wheat and *boro* harvests, however, was of course not yet available for households to consume in the six months immediately following the floods.

The government of Bangladesh responded to the crisis by supplying food for immediate relief efforts during the floods and by helping to coordinate food aid commitments and deliveries. At the same time, as part of its price stabilization strategy, the government encouraged private sector imports, a policy that helped avoid a food supply shortage following the floods.

Government Foodgrain Distribution

Major flood relief efforts began in August 1998 through the provision of 20,400 tons of rice through Gratuitous Relief (GR) in flood-affected *thanas* and an additional 30,800 tons of rice in September. In addition, the Vulnerable Group Feeding (VGF) program began on a large scale in August with an initial distribution of 1.3 million cards, which entitled the holder to 8 kilograms of rice per month. During August and September, 27,500 tons of rice were distributed through this program. At 8 kilograms per card, an estimated 1.35 million households received VGF rations in August and 2.13 million households in September. Almost no wheat was distributed through relief channels in the early months of the floods.

In late September, the World Food Programme (WFP) strongly urged the government of Bangladesh to expand the VGF program to 4 million cards (households) with an allotment of 32 kilograms of wheat per card. The WFP urged that this expansion take effect for both September and October, but the 141,680 tons of wheat needed for two months' distribution would have had to come almost exclusively from government stocks because little food aid had arrived.[23] Recognizing the urgent need for more relief to poor, flood-affected households, the government of Bangladesh agreed to the expansion in the number of VGF cards to 4 million. However, given that delays in food aid arrivals were likely, the allotment was reduced to 8 kilograms of rice and 8 kilograms of wheat per card for October only, postponing a decision on the November distribution until more definite information on food aid arrivals was available.

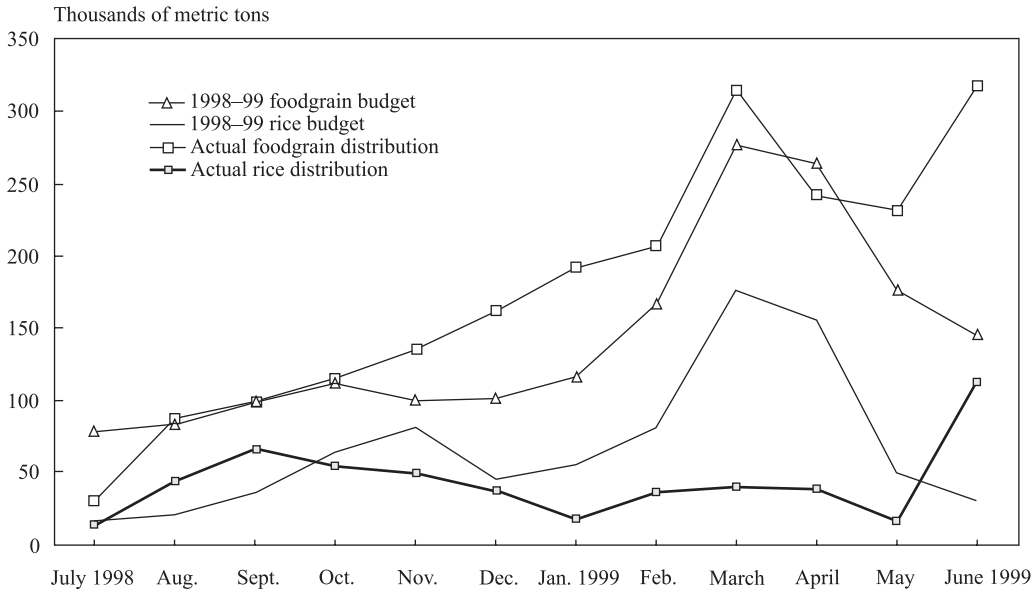
Initial estimates of foodgrain availability greatly overestimated the arrivals of foodgrain because of unforeseen delays in shipments and unloading. By the end of October, only 52,000 tons of food aid had actually arrived, 71,000 tons less than assumed by the WFP in its late-September analysis. During November, only an additional 25,000 tons of food aid wheat arrived and were available for distribution, so that, by the end of November, cumulative food aid arrivals were only 77,000 tons, compared with the WFP-projected 431,000 tons. Fortunately, the government of Bangladesh's own commercial imports of 224,000 tons of wheat arrived and were unloaded from mid-October to early November 1998, permitting a continuation of the expanded VGF program in November as well.

The VGF program was again expanded in December 1998, to cover 4.2 million households with an increase in the ration size to 20 kilograms per card (5 kilograms of rice and 15 kilograms of wheat) for the month of Ramadan. No distribution of foodgrains through the VGF program took place in January, but the program restarted in February with a ration size for February through April of 15 kilograms of wheat and 5 kilograms of rice per card.

Altogether, planned offtake for 1998/99 was increased from 1.718 million tons to

[23] The government of Bangladesh also explored the possibility of drawing on the food security reserve of the South Asian Association for Regional Cooperation (SAARC) or direct purchases from the government of India. However, administrative procedures were found to be very cumbersome and no agreement could be reached on a sales price of grain for transactions with the government of India, so ultimately no foodgrain came through government-to-government channels.

Figure 3.2 The government's budgeted and actual distribution of rice and total foodgrains, 1998/99



Source: Food Planning and Monitoring Unit, Ministry of Food.

2.279 million tons. Through December, however, limited government wheat stocks, uncertainties about rice supplies after the *aman* harvest, and financial constraints limited total distribution to 630,000 tons, only 26,000 tons more than in the pre-flood government distribution for this period (Figure 3.2). Rice distribution was greater than originally planned only in August and September, mainly because of VGF distribution. Thereafter, it was significantly less than planned, especially in March and April because originally budgeted open market sales (OMS) did not take place. The story for wheat is the exact opposite. Actual wheat distribution was below initial plans in August and September, and exceeded initial plans every month thereafter. To a large extent, additional foodgrain distributed through VGF and other relief channels was offset by reductions in previously budgeted OMS rice sales and a postponement of planned Food for Education (FFE) disbursements. Later, disbursements for Food for Work (FFW) fell behind schedule so that total distribution of foodgrains through April 1999 was only 1.578 million tons, 69 percent of the target for the entire fiscal year.

The VGF program accounted for 29.3 percent of the total distribution of foodgrains from July 1998 through April 1999 (that is, up until the 1998 *boro* rice harvest): 167,000 tons of rice and 296,000 tons of wheat. Gratuitous Relief accounted for 65,000 tons of rice and 7,000 tons of wheat, or 4.6 percent of total distribution. Food for Work, which began on a large scale only in January 1999 when soil conditions permitted heavy earthwork, accounted for 26.0 percent of distribution; Test Relief accounted for another 3.2 percent. In all, these four relief channels accounted for 63.1 percent of distribution.

For the entire July 1998–June 1999 fiscal year, Food for Work wheat offtake was 690,000 tons, or 32.3 percent of the total offtake of foodgrains (2.133 million tons). Overall, increases in Food for Work (173,000 tons) and Vulnerable Group Feeding (435,000 tons) were the major components of the 415,000 ton increase in 1998/99 food distribution compared with the original budget (Table 3.3).

Table 3.3 Budgeted and actual foodgrain distribution, by channel, 1998/99 (thousand metric tons)

	Budget 1998/99			Actual 1998/99		
Channel	**Rice**	**Wheat**	**Total**	**Rice**	**Wheat**	**Total**
Priced channels						
Essential priorities (EP)	124	85	209	127	85	212
Open market sales (OMS)	200	0	200	2	0	2
Fair price campaign (FPC)	0	0	0	9	5	14
Other priority (OP)	6	6	12	7	5	12
Large employee industries (LEI)	0	15	15	0	14	14
Non-priced channels						
Food for Work (FFW)	125	400	525	8	690	698
Vulnerable Group Development (VGD)	60	120	180	11	193	204
Food for Education (FFE)	150	200	350	60	227	287
Test Relief (TR)	40	16	56	37	53	90
Vulnerable Group Feeding (VGF)	20	10	30	168	297	465
Gratuitous Relief (GR)	66	24	90	66	8	74
Others	22	29	51	36	24	60
Total	813	905	1,718	530	1,603	2,133

Source: Food Planning and Monitoring Unit, Ministry of Food.

Rice and Wheat Markets Following the Floods

Government rice policy was based on the realization that government imports and food aid alone would not be sufficient to make up the projected 1.9 million ton shortfall in foodgrain supplies before the wheat and *boro* harvests in April–June of 1999. Thus, the government encouraged private sector imports of rice, a policy that predated the floods.

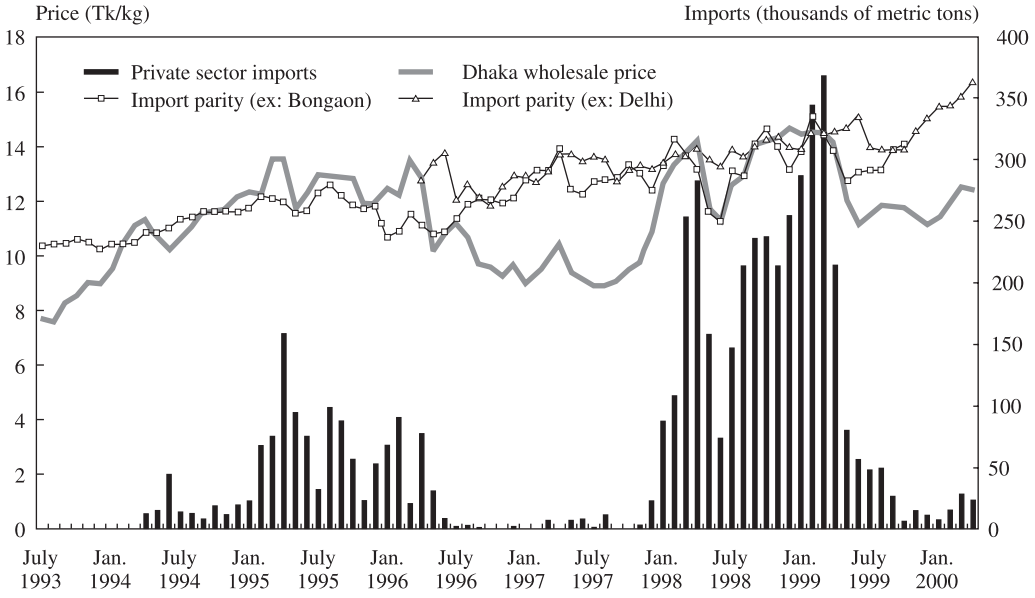
Private Sector Rice Imports

As shown in Figure 3.3, market prices of rice had been high in the first half of 1998, even before the floods, because of a poor 1997/98 *aman* rice harvest in November–December 1997. Domestic prices rose swiftly to import parity levels (equal to the cost of rice in Indian markets plus transport, handling, and a normal profit margin), thus making it profitable for the private sector to import rice from India. Private sector imports of rice had been permitted since 1994,[24] but in early 1998 the government of Bangladesh took deliberate steps to encourage private sector imports of rice through removal of a 2.5 percent tariff on imports, limitations on government open market rice sales, instructions to expedite clearance of rice imports through customs, and a decision not to reimpose anti-hoarding laws. As a result, during the first five months of 1998, the private sector imported 894,000 tons of rice from India (according to government of Bangladesh customs figures), mainly by truck and rail across land borders.

With the onset of the *boro* rice harvest in May, the national average wholesale price of coarse HYV rice fell from a peak of Tk 14.2 per kilogram in April to Tk 12.0 per kilogram in June, and private imports slowed to 59,000 tons in June. Soon thereafter, as the floods began, however, prices again rose to import parity. By continuing its policy of encouraging private sector imports, the government enabled the private sector to import substantial quantities of rice and keep the domestic market price from rising above import parity levels. According to official government of Bangladesh estimates, more than 200,000 tons of rice per month were imported from August 1998 to March 1999, with private rice imports reaching 288,000

[24] Wheat imports were liberalized in 1992/93.

Figure 3.3 Rice prices and quantity of private sector rice imports in Bangladesh, 1993–2000



Source: Dorosh 1999a, calculated using data from the Food Planning and Monitoring Unit, Ministry of Food; Marketing Information System (MIS), Directorate General of Food; CMIE 1998–2000; and Baulch et al. 1998.
Notes: Price data for April 2000 are up to the fourth week only; private sector imports are as of April 26, 2000. Since November 1998, the carrying cost has increased by Tk 1.1 per kilogram. Since January 2000, a 5 percent tax has been imposed on rice imports.

tons in January and 345,000 tons in February, 1999.[25]

Thus, because of the poor 1997/98 *aman* harvest and the flood-damaged *aus* and *aman* harvests in 1998/99, Bangladesh rice prices (wholesale Dhaka) remained close to ex: India import parity prices for most of calendar year 1998.[26] Wholesale prices after the floods were in fact remarkably stable. The national average wholesale prices of coarse rice remained in the range of Tk 14.14–14.83 per kilogram from September 1998 through mid-April 1999.[27] With a good *boro* harvest in April and May, market prices fell by 19 percent, from Tk 14.46 per kilogram (*aman* coarse rice) in the third week of April to Tk 11.74 per kilogram (*boro* HYV rice) in the second week of May, bringing to an end a nine-month period of high rice prices and concerns about post-flood food availability.

Note that the large quantities of private sector rice imports during 1998 and early 1999 were unprecedented in Bangladesh. Prior to 1994, when international trade in rice was liberalized, private sector imports were not permitted. And, for about one and a half years prior to the poor *aman* harvest in 1997/98, rice prices in Bangladesh had been significantly below the cost of rice imported from India. As a result, there were essentially no private sector imports of rice from June 1996 to December 1997. The only other pe-

[25] The extremely high figures for recorded rice imports in early 1999 may overstate actual rice imports. It is possible that other commodities were imported using false invoices to avoid import tariffs and other surcharges.

[26] In Figure 3.3, a marketing margin of Tk 2.0/kilogram is used to calculate the West Bengal import parity prices shown for July 1993 to September 1997.

[27] Note that Figure 3.3 shows that domestic prices were Tk 0.5–2.0 below ex: Delhi import parity prices from May through August 1998, yet private sector imports continued. The main explanation is that rice exports during this period originated mainly from West Bengal's *rabi* (*boro*) crop, where prices are generally Tk 1.5–2.0/kilogram lower than Delhi prices during this season (as evidenced in the data from 1996 and 1997).

Table 3.4 Wholesale rice prices in Bangladesh, 1997/98 and 1998/99

	Average price (Tk/kg)		Standard deviation		Maximum/minimum		Number of markets	
	1997/98	1998/99	1997/98	1998/99	1997/98	1998/99	1997/98	1998/99
July	9.20	12.37	0.64	0.68	1.37	1.31	57	61
August	9.24	13.32	0.62	0.70	1.33	1.28	56	57
September	9.47	14.32	0.61	0.82	1.33	1.29	42	52
October	9.99	14.29	0.64	0.72	1.32	1.24	55	53
November	9.79	14.05	0.62	0.66	1.30	1.25	41	36
December	11.10	14.34	0.92	0.89	1.41	1.32	43	36
January	12.55	14.34	0.83	0.87	1.33	1.35	50	46
February	13.34	14.60	0.84	0.78	1.28	1.26	48	42
March	13.67	14.58	0.66	0.77	1.24	1.29	46	47
April	14.15	13.49	0.80	0.86	1.27	1.34	39	37
May	11.90	11.72	0.86	0.90	1.38	1.43	49	50
June	11.32	11.83	0.81	1.01	1.39	1.55	60	58
Average:								
August–September	9.36	13.82	0.61	0.76	1.33	1.29	49	54
Annual average	11.31	13.60	0.74	0.80	1.33	1.33	49	48

Sources: Department of Agricultural Marketing unpublished data and authors' calculations.

riod of large-scale private sector rice trade was April 1994 to June 1996, when 1.31 million tons were imported, about 39 percent of the total imported in the 16-month period from January 1998 through April 1999 (see Dorosh 1999b).

Government Interventions in the Domestic Rice Market

In comparison with private sector rice imports, government interventions in the domestic rice market were small, only 399,000 tons from July 1998 through April 1999. Private sector rice imports, at 2.42 million tons in this period, were 6.1 times larger than government rice distribution. Of the rice distribution, 57.7 percent was targeted to flood-affected households through Vulnerable Group Feeding (41.5 percent) and Gratuitous Relief (16.2 percent). However, total rice distribution during these months was only slightly above the original target, in part because the Ministry of Food faced substantial difficulties in procuring rice through either domestic or international tenders.

Problems related to the instability of prices and unreliability of suppliers limited actual procurement of rice through commercial international tenders to only 94,670 tons out of 310,000 tons in contracts through March 8, 1999 (31 percent of contracted amount). Local tenders faced similar problems: five local tenders for 295,000 tons of rice resulted in only 17,000 tons of procurement from 174,000 tons contracted (10 percent of the contracted amount) through March 15, 1999. Efforts to procure grain through the Bangladesh State Trading Corporation likewise resulted in little procurement.

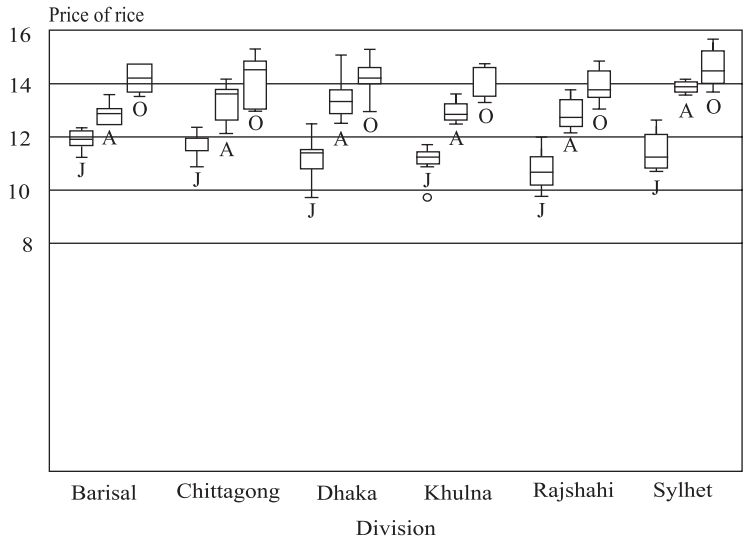
Regional Rice Markets

Because Bangladesh domestic wholesale markets for rice are well integrated, the influx of imports stabilized not only the price in Dhaka but the price throughout Bangladesh as well. Overall, the extent of rice price variations across wholesale markets throughout Bangladesh was similar in the flood year 1998/99 to those in 1997/98, a nonflood year (Table 3.4). Though rice prices were on average 48 percent higher in August and September 1998 compared with the same months in 1997, the ratio of the maximum to minimum prices observed across markets was actually slightly less in 1998/99 (1.29 compared with 1.33). The standard deviation of rice prices was higher, however, indicating that more market prices were relatively

far from the mean price in 1998/99 than in 1997/98.

Figure 3.4 shows the dispersion of monthly average prices across districts within the six divisions of Bangladesh in June, August, and October 1998. Prices rose sharply across all divisions between June and August, though the price rise was steepest in Rajshahi, Dhaka, and Sylhet. In these major *boro* rice-growing divisions, prices were generally lower than in the rest of the country at the time of the *boro* harvest in June, but rose to levels closer to the national average at the peak of the floods in August. The largest wholesale price variations across districts in August and October occurred in Chittagong and Dhaka divisions. Nonetheless, the variations across districts remained relatively small—the ratio of the maximum to minimum average district price was 1.17 to 1.20 in these divisions during August and October.

Figure 3.4 Variations in wholesale rice prices across districts in Bangladesh, 1998



Sources: Department of Agricultural Marketing data and authors' calculations.
Notes: This figure shows price variations across districts within each of the six divisions of Bangladesh. The boxes on this whisker plot denote the range of prices from the 25th percentile to the 75th percentile the interquartile range (IQR). The median price is shown by the line in the middle of the box. The lines emerging from the box (called whiskers) extend to the largest (smallest) data point less (greater) than or equal to the 75th (25th) percentile plus (minus) the IQR. J = June, A = August, and O = October.

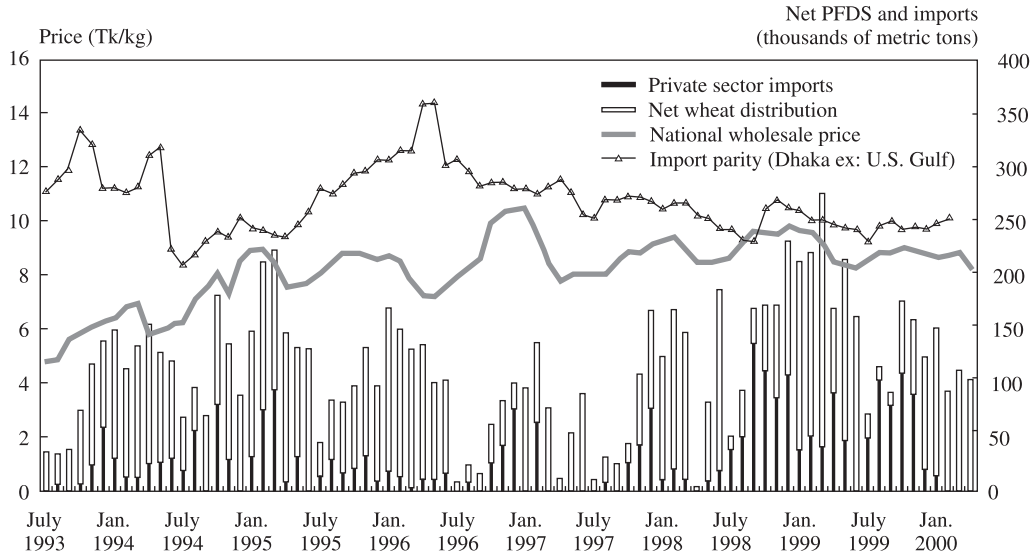
Domestic Wheat Markets

Somewhat surprisingly, the private sector continued to import substantial volumes of wheat following the floods, even though large amounts of wheat food aid flowed into Bangladesh and distribution through VGF and Food for Work was expanded. In January and February 1999, 90,000 tons of wheat were imported, raising total wheat imports from July 1998 through February 1999 to 624,000 tons, 435,000 tons more than in the same period in 1997/98. As shown in Figure 3.5, domestic wheat prices were slightly below calculated import parity prices based on wheat export prices in the United States (U.S. Hard Red Winter, No. 2, FOB Gulf of Mexico). However, much of the imports in early 1999 came from other exporters, including Turkey, Australia, and Central Asian countries. (The quality and cost of transport differences likely account for the deviation between calculated import parity and domestic prices of wheat.[28]) Thus, given the large private sector imports, it appears that food aid inflows did not provide a disincentive for domestic wheat producers.

Overall, the supply of wheat in Bangladesh was 3.87 million tons in 1998/99, an increase of 46 percent over 1997/98. The large increase in apparent wheat consumption may be explained by several factors: (1) the effects of high rice prices on wheat consumption (as determined by the cross-price elasticity of demand for wheat with respect to the rice price); (2) the adverse income effects of the floods, which may have induced some households to substitute wheat for rice (given a negative income elasticity of demand for wheat in rural areas); (3) the secular increase in wheat consumption as tastes for wheat change over time, in part owing to the use of higher-protein wheat for milling into flour for baking; (4) the positive income effects of

[28] Reportedly, much of the wheat imported by the private sector during the flood was lower-quality "feed" wheat, brought into Bangladesh with false papers (personal communication with private sector importers).

Figure 3.5 Wheat prices, quantity of private sector wheat imports, and net public wheat distribution in Bangladesh, 1993–2000



Sources: Food Planning and Monitoring Unit, Ministry of Food; Department of Agricultural Marketing; Marketing Information System (MIS), Directorate General of Food; U.S. Department of Agriculture; and CMIE 1998–2000.
Notes: Domestic price data for April 2000 are up to the first week only; private sector imports are as of January 14, 2000; and net public food distribution system data are as of March 31, 2000. The import parity price is based on U.S. No. 2 Hard Red Winter and includes import tariffs.

wheat transfers to very poor, flood-distressed rural households; and (5) increased use of lower-quality wheat as animal feed.

Private Foodgrain Imports and National Food Security

Alternative Estimates of the Volume of Rice Imports and Availability

The behavior of market prices in Bangladesh suggests that rice imports from India were a major source of supply. The volume of this rice trade remains somewhat uncertain, however, for two major reasons. First, Bangladesh import data differ substantially from India export data. Second, calculations of the total availability of rice in Bangladesh are not consistent with market price movements and estimated rice demand.

Comparisons of Bangladeshi rice import data and Indian rice export data since the liberalization of the private sector rice trade by Bangladesh in 1994 indicate a systematic overstating of rice imports by Bangladesh compared with exports by India. For example, according to Bangladesh customs data, 3.172 million tons of rice were imported from India from April 1998 through March 1999, 2.827 million tons (89.1 percent) by the private sector.[29] Indian data on the quantity of rice exports to Bangladesh[30] indicate that in 1998/99 exports totaled only 2.215 million tons, 958,000 tons (30.2 percent) less than the Bangladesh customs figures.[31]

[29] The data are presented according to India's April–March fiscal year in order to permit direct comparison.

[30] Estimated using the values of basmati and non-basmati rice exports to Bangladesh and the average prices of total Indian exports of these two types of rice (Dorosh 2001). Note that non-basmati rice accounted for 99.8 percent of the value of rice exports to Bangladesh in 1998/99 (CMIE 1999).

[31] Possible explanations for the discrepancies in the data are false customs declarations to avoid import duties on non-rice products, capital flight from Bangladesh, or simply reporting mistakes in one or both countries (Dorosh 2001). Note that smuggling of rice from India is not a likely explanation of the discrepancies since this rice would be unlikely to enter Bangladesh through official customs channels, and, as shown below, demand calculations indicate that the official figure for the volume of Bangladesh rice imports appears to be overstated.

Table 3.5 Estimated rice demand and implicit private stock change, 1996/97– 1998/99

	1996/97 Total year Dec.–Nov.	1996/97 *aman* Dec.–Apr.	1997 *boro*, *aus* May–Nov.	1997/98 *aman* Dec.–Apr.	1998 *boro*, *aus* May–Nov.	1998/99 *aman* Dec.–Apr.
Rice production	18.884	9.550	9.334	8.850	9.595	7.700
Aman	9.550	9.550	0.000	8.850	0.000	7.700
Boro	7.460	0.000	7.460	0.000	7.979	0.000
Aus	1.874	0.000	1.874	0.000	1.616	0.000
Losses, seed, etc. (10 percent)	1.888	0.955	0.933	0.885	0.960	0.770
Net production	16.996	8.595	8.401	7.965	8.636	6.930
Domestic procurement (Dec.-Apr.)/(May-Nov.)	0.444	0.201	0.243	0.040	0.322	0.057
Offtake from government stocks	0.672	0.365	0.307	0.299	0.365	0.170
Private imports	0.035	0.004	0.031	0.758	1.285	1.472
Supply less private stock change	17.259	7.160	10.112	6.999	9.883	7.050
Demand	17.259	7.160	10.112	6.999	9.883	7.050
Implicit private stock change[a]	0.000	1.603	–1.616	1.983	0.081	1.465
Stock change relative to 1996/97[b]	. . .	. . .	. . .	0.379	1.697	–0.138
Price of rice (Tk/kg)	. . .	9.572	9.754	12.982	13.240	14.402
Real price (Tk/kg) (1996/97 prices)	9.553	9.572	9.535	12.405	12.367	13.150
Per capita demand (kg/period)	70.443	58.686	82.208	56.447	79.063	55.956
Change in per capita demand (%)	. . .	–0.03	0.03	–3.84	–3.80	–4.68

Source: Authors' calculations.

Notes: The unit of measure is million metric tons unless otherwise noted.
[a] Also includes possible overestimates of production and imports, and underestimates of consumption.
[b] The difference between the implicit stock change in the season specified and the implicit stock change in the same season in 1996/97.

Examination of calculated rice availability and movements in market prices in Bangladesh gives another indication of the volume of rice imports from India in recent years (Table 3.5). In 1996/97, the most recent fiscal year in which private imports were negligible (only 35,000 tons), net supply—calculated as the sum of net production, net government distribution (offtake less domestic procurement), and private imports, assuming no change in private stocks—was 17.259 million tons. Using the 1996/97 level of per capita consumption and the real price of rice as a base, per capita demand for rice in each period is calculated using the percentage change in the real price of rice and an assumed own-price elasticity of demand for rice of –0.15. Then, using the level of population in each period, total rice consumption is estimated.[32] Finally, the difference between net supply and the calculated demand is reported as the implicit private stock change.

Thus, for example, real prices of coarse rice (national average) in the December through April period following the 1996/97 *aman* rice harvest averaged Tk 9.57 per kilogram, 0.63 percent higher than the average real price for 1996/97. Assuming an own-price elasticity of demand for rice of –0.15, per capita consumption of rice fell by 0.09 percent. Total demand for the period is estimated at 7.16 million tons, resulting in an implicit private stock change of 1.61 million

[32] Income effects are ignored for three reasons. First, income elasticities of demand for rice are relatively small—about 0.4 for rural households and 0.15–0.27 in urban areas (Goletti 1993; Shahabuddin and Zohir 1995). Second, per capita incomes at a national level did not fall significantly. Third, as shown in Chapter 6, there was substantial borrowing by flood-exposed households.

Table 3.6 Implicit private stock changes under alternative assumptions for own-price elasticity of rice demand (million metric tons)

Own-price elasticity of rice demand	1996/97 Total year Dec.–Nov.	1996/97 *aman* Dec.–Apr.	1997 *boro*, *aus* May–Nov.	1997/98 *aman* Dec.–Apr.	1998 *boro*, *aus* May–Nov.	1998/99 *aman* Dec.–Apr.	Total Dec. 97–Apr. 99
Elasticity = 0.0							
Implicit private stock change[a]	0.000	1.601	–1.613	1.703	–0.309	1.119	2.512
Stock change relative to 1996/97[b]	. . .	. . .	. . .	0.102	1.304	–0.482	0.923
Elasticity = –0.1							
Implicit private stock change[a]	0.000	1.603	–1.615	1.891	–0.048	1.351	3.194
Stock change relative to 1996/97[b]	. . .	. . .	. . .	0.288	1.567	–0.251	1.604
Elasticity = –0.15							
Implicit private stock change[a]	0.000	1.603	–1.616	1.983	0.081	1.465	3.528
Stock change relative to 1996/97[b]	. . .	. . .	. . .	0.379	1.697	–0.138	1.938
Elasticity = –0.2							
Implicit private stock change[a]	0.000	1.604	–1.617	2.073	0.208	1.577	3.858
Stock change relative to 1996/97[b]	. . .	. . .	. . .	0.469	1.825	–0.027	2.266

Source: Authors' calculations.

[a] Also includes possible overestimates of production and imports, and underestimates of consumption.
[b] The difference between the implicit stock change in the season specified and the implicit stock change in the same season in 1996/97.

tons between the start of December 1996 and the end of April 1997. This estimated stock change can be considered a normal change in private stocks for this period, given the seasonality of production and prices.

Similar calculations for the December 1997 through April 1999 period (consisting of a full year of harvests, plus the flood-damaged December 1998 *aman* crop) suggest that, in response to the sharp increase in average real prices of rice in Bangladesh, per capita demand was 3.85 to 4.83 percent less than in 1996/97. The implicit stock change for these 17 months (the difference between total demand and apparent availability) was thus 3.528 million tons, 1.938 million tons greater than the typical stock change estimated for the December 1996–April 1997 period (Table 3.6). A change in private stocks of this magnitude seems highly unlikely, given that the periods are defined to end just before major harvests.

Three other major factors might account for this large discrepancy between calculated demand and net supply: overestimation of production, overestimation of imports, and underestimation of consumption. Since production is the largest single determinant of supply and the implicit stock change, a rather small percentage change in production estimates could account for the difference between net supply and estimated demand. For example, a 9.1 percent overestimation of the total net rice production of the four rice harvests from December 1997 through April 1999 of 23.53 million tons (net of 10 percent for seed, feed, and wastage) would account for the entire excess implicit stock change. Similarly, the 958,000 tons total discrepancy between Bangladeshi import data and Indian export data for April 1998 to March 1999 reported above is equal to about half (49.4 percent) of the excess implicit stock change.

Plausible changes in the slope of the demand curve, as measured by the own-price elasticity of demand, have a smaller effect on the calculations of implicit stock change. A less price-responsive (more price-inelastic) demand implies a smaller reduction in demand following large price increases, and thus a smaller implicit stock increase. However, even with an own-price elasticity of demand of 0.00 (compared with –0.15 used

in Table 3.5), the excess implicit stock change is still 923,000 tons (Table 3.6).[33]

In principle other factors could affect the calculations of implicit stock change, including demand factors such as shifts in income or cross-price effects. But, given that the own-price elasticity of rice appears to be rather small, and that little widespread per capita income growth was likely in a period that included two major rice production shortfalls and a major flood, significant positive income effects on demand seem unlikely. Similarly, given the low cross-price effects of other prices on rice consumption (owing to the large budget share of rice), cross-price effects are likely also to be negligible.

The above calculations strongly suggest that total supply has been overestimated for the December 1997 through May 1999 period. An overestimate of Bangladesh rice imports is insufficient in itself to explain the large implicit stock change (assuming these imports were at least as large as stated in the Indian export data). Nonetheless, an overestimate of imports could account for as much as about half of the difference between net supply and estimated rice demand.

Market Prices in the Absence of Private Sector Imports

Though the quantity of private sector imports from India is uncertain, it is clear that this trade substantially augmented Bangladesh rice supplies in 1997/98 and 1998/99. One measure of the impact of this trade on national food security in Bangladesh is to compare actual prices and imports with estimates of prices and imports in the absence of private sector imports from India. Given the average wholesale price of coarse rice in Dhaka of Tk 13.3 per kilogram in 1998/99, rice imports from December 1997 through November 1998 were 2.043 million tons (according to the Bangladesh customs data). Had rice imports from India not been available, the next lowest cost source for private importers would have been Thailand,[34] for which the import parity price of 15 percent broken rice in Dhaka in the same period was Tk 16.1 per kilogram. Given this 20.9 percent increase in the import parity price, estimated rice demand would have fallen by between 4.2 and 6.3 percent, assuming an own-price elasticity of rice demand of –0.2 to –0.3. In this case, rice imports would have declined by approximately 700,000 to 1 million tons.[35]

If private sector imports were unavailable (or banned) from any source, then, with no change in government imports, total supply would have been 12.1 percent less (apart from private stock changes) and rice prices could have risen by 40–60 percent, to an average of between Tk 18.7 and Tk 21.3 per kilogram.[36] Such an increase in the rice price level would likely have been unacceptable to the government of Bangladesh and public sector imports would have been increased. However, public sector imports of a magnitude equal to private sector flows would not have been feasible.

During the 1998 calendar year alone, private sector imports, mainly from India, reached 2.26 million tons. Had the government of Bangladesh imported this grain itself, the average cost of the imported rice delivered to local delivery points would have been approximately Tk 14.9–15.9 per kilogram, Tk 1.0–2.0 per kilogram above the private sector import costs, owing to additional marketing costs of US$50–100 million. And, if the government had received a

[33] Moreover, note that an own-price elasticity of demand of –0.15, though consistent with time-series estimates in Dorosh (1999b), is low compared with cross-section estimates of –0.56 from Goletti (1993).

[34] Bangladesh consumes mostly parboiled rice (in the parboiling process, the paddy is first boiled and then milled). The other major Asian exporter, Vietnam, sold only white (non-parboiled) rice in this period.

[35] This calculation assumes no problems with the supply of imports from Thailand, an issue discussed below.

[36] In the absence of private sector imports, domestic supply would have been 14.839 million tons, a 12.1 percent reduction in per capita supplies relative to the actual estimated levels. Assuming an elasticity of demand of –0.2 to –0.3, prices would need to rise by 12.1/0.3 (40 percent) to 12.1/0.2 (60 percent) to equilibrate market supply and demand.

net price of Tk 11.5 per kilogram (the open market sales price of Tk 12.0 per kilogram less Tk 0.5 per kilogram OMS dealer's commission), the total unit subsidy would have been Tk 3.4–4.4 per kilogram, and the total fiscal cost would have been US$160–210 million.

The Competitiveness of the Private Rice Import Trade

In spite of the potentially high costs of massive government imports, such expenditures might be deemed necessary if there was evidence that private traders were manipulating the market. One indication that the rice market was competitive in Bangladesh was that the margin between wholesale prices in Dhaka and India remained relatively low and stable.[37] Data from letters of credit from both 1994/95 and 1998 suggest that a large number of traders participated in rice imports, another indication of a competitive market.[38]

Letters of credit data from 1994/95 indicate that most of the rice imported from India came in small lots. The average size of the 1,251 shipments of rice in 1994/95 was only 707 tons. Letters of credit data from January through mid-September 1998 indicate an even smaller average quantity of only 268.7 tons per letter of credit for the 3,291 letters of credit issued. Moreover, these letters of credit were opened by 793 different traders, with an average amount of imports per trader of only 1,115 tons of rice. The largest 10 traders (in terms of total imports) imported 142,369 tons, or 16 percent of the total. Given this broad participation in the rice import trade and the small share of the largest suppliers, it appears that there has been little scope for individuals or a small group of traders to significantly affect market prices by restricting market supply (Dorosh 1999b).

However, private sector imports from Thailand are likely to involve far fewer traders because of economies of scale in sea shipments. Whereas cross-border trade involves shipments of approximately 10 tons per truck or 70 tons per railway wagon (generally grouped together in a rack of 24 wagons carrying about 1,600 tons), typical ocean shipments involve 10,000–15,000 tons of rice. Thus, instead of hundreds of participating traders, it is likely that only the larger traders would be able to finance such large shipments. Of course, competition is still possible even if the number of importers is only 5 or 10, but the risk of collusion is high.[39]

Reliability of the Indian Rice Market as a Source of Supply

Fortunately for Bangladesh, market supplies of rice in India in 1998/99 were plentiful. Production of the *kharif* rice crop, which accounts for about 85 percent of India's rice production, was 71.84 million tons, only about 0.9 percent below the 1997/98 bumper crop. Moreover, Food Corporation of India rice stocks on October 1, 1998, were quite high (8.7 million tons), nearly 3 million tons above the buffer stock norm of 6 million tons for that date. Wheat stocks were even higher: 15.8 million tons on September 1, 1998.

Large-scale private imports from India were possible in 1998/99 because, with large government stocks of foodgrains and a good rice harvest, the government of India was willing to allow exports. Had stocks and/or production been lower, an export quota or even an export ban could have been imposed. One important factor, then, is the probability that both Bangladesh and India will have poor rice harvests in the same year.

As shown in Table 3.7, from 1971/72 through 1998/99, total production of rice in Bangladesh fell about 5 percent or more

[37] As indicated in Figure 3.3, the marketing margin for shipment of rice by truck increased by approximately Tk 1.1 per kilogram in November 1998 owing to new weight restrictions on truck loads in both India and Bangladesh.

[38] See Murshid (1999) for details of the private sector rice import trade.

[39] One safeguard against collusion is to encourage international grain companies to participate in the import trade as well.

Table 3.7 Total production of *aman* and *kharif* rice in Bangladesh and India (million metric tons) and percentage deviation from trend, 1971–99

	Bangladesh				India			
Year	Aman production	Percentage deviation	Rice production	Percentage deviation	Kharif production	Percentage deviation	Rice production	Percentage deviation
1970/71	6.22	–3.54	11.14	10.36	39.56	12.63	42.22	16.28
1971/72	6.12	–6.53	9.93	–4.94	39.99	9.57	43.07	13.20
1972/73	5.90	–11.33	10.09	–6.54	36.32	–4.10	39.24	–1.38
1973/74	7.10	4.99	11.91	6.84	40.90	4.21	44.05	6.08
1974/75	6.29	–8.51	11.29	–1.82	35.93	–11.58	39.58	–8.52
1975/76	7.45	6.79	12.76	7.74	44.74	6.52	48.74	8.30
1976/77	7.31	3.13	11.75	–3.63	39.27	–9.49	41.92	–10.32
1977/78	7.86	9.25	12.97	3.39	48.95	9.36	52.67	8.64
1978/79	7.89	8.07	12.85	–0.35	49.34	6.94	53.77	7.07
1979/80	7.11	–3.95	12.74	–3.81	38.49	–19.00	42.33	–18.53
1980/81	7.96	6.01	13.88	2.10	50.09	2.46	53.63	–0.13
1981/82	7.21	–5.37	13.63	–2.26	49.24	–2.03	53.25	–3.94
1982/83	7.60	–1.56	14.22	–0.55	42.70	–17.32	47.12	–17.59
1983/84	7.94	1.36	14.51	–0.92	55.05	3.84	60.10	2.01
1984/85	7.93	–0.07	14.62	–2.47	53.78	–1.13	58.34	–3.81
1985/86	8.54	6.17	15.04	–1.99	59.39	6.49	63.83	2.30
1986/87	8.27	1.43	15.41	–1.82	53.56	–6.28	60.56	–5.57
1987/88	7.69	–6.88	15.41	–3.92	49.05	–16.19	56.86	–13.68
1988/89	6.86	–18.01	15.54	–5.17	63.38	5.80	70.49	4.26
1989/90	9.20	8.64	17.86	6.66	65.88	7.51	73.57	6.09
1990/91	9.17	6.89	17.85	4.45	66.32	5.85	74.29	4.51
1991/92	9.27	6.75	18.25	4.65	66.37	3.65	74.68	2.55
1992/93	9.68	10.13	18.34	3.09	65.24	–0.25	72.87	–2.27
1993/94	9.42	5.88	18.04	–0.55	70.72	5.90	80.30	5.24
1994/95	8.50	–5.54	16.83	–8.96	72.60	6.52	81.81	4.83
1995/96	8.79	–3.51	17.69	–6.12	67.88	–2.39	76.98	–3.52
1996/97	9.55	3.65	18.88	–1.60	71.42	0.71	81.31	–0.25
1997/98	8.85	–5.07	18.85	–3.53	72.50	0.29	83.50	0.29
1998/99	7.74	–17.96	19.91	0.08	71.84	–2.48	86.00	1.18

Sources: Food Planning and Monitoring Unit and authors' calculations.
Note: Trend values have been derived from linear regression.

below trend in only five years: 1971/72, 1972/73, 1988/89, 1994/95, and 1995/96. India's production has been more variable over the period as a whole, with six years 5 percent or more below trend: 1974/75, 1976/77, 1979/80, 1982/83, 1986/87, and 1987/88. However, from 1988/89 to 1998/99, India's annual rice production did not fall more than 5 percent below trend in any year.

One reason for the greater stability in Bangladesh's annual production is that the *boro* harvest, coming only about five months after the *aman* harvest, acts as a natural stabilizer of domestic production. Poor *aman* harvests are often followed immediately by good *boro* harvests owing to greater price incentives for production, enhanced government extension and input supply efforts, and a desire on the part of farmers to build up own-stocks of rice.

Comparing only *aman* production in Bangladesh with *kharif* production in India tells a somewhat different story. From 1980/81 through 1998/99, production of *aman* in Bangladesh fell below trend in four years: 1981/82, 1987/88, 1988/89, 1994/95, and 1998/99, but in 1988/89 and 1998/99, *aman* production was 17.44 (1988/89) and 18.33 percent (1998/99) below trend. India also experienced three years of substantial *kharif* rice production shortfalls in the 1980s: 1982/83 (17.32 percent), 1986/87 (6.49 percent), and 1987/88 (16.41 percent). Since 1980/81, only in 1986/87 did both India and Bangla-

desh have a 5 percent or greater shortfall in the *aman*/*kharif* crop. Since that year, India's *kharif* rice production has been above or only slightly below trend, and in the two most recent years of very low *aman* harvests in Bangladesh (1988/89 and 1998/99), India's *kharif* production was 5.80 percent above and 2.48 percent below trend. Overall, the correlation coefficients of the error terms of linear time-trend regressions of rice production are 0.34 for *aman* and *kharif* production and 0.30 for total production in Bangladesh and India.

Past trends are, of course, not perfect predictors of the future. But the lack of correlation between poor Indian harvests and poor Bangladeshi harvests has an agronomic basis. India's *kharif* rice production is spread over a much wider area than Bangladesh's *aman* rice production, so weather effects are likely to vary more across India's *kharif* rice-producing zone, reducing the risk of weather-related failure of the entire crop. In particular, high rainfall or excessive snowmelt in the Himalayas that cause flooding in Bangladesh and parts of eastern India do not necessarily correlate with poor weather in other regions of India.

In spite of the low correlation of production shortfalls, it is nonetheless prudent for the Bangladeshi government to be prepared for such an occurrence. In such a situation, rice imports would likely have to come mainly from Thailand at somewhat higher cost than imports from India; fewer private traders would be involved, and shipping schedules and problems at Chittagong port might hinder the smooth arrival of rice imports.

A Comparison with Earlier Major Production Shortfalls

As shown above, 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 foodgrain 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 30,000–100,000 deaths, followed floods that damaged *aus* and *aman* crops.[40] The 1988 floods, in contrast, 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 had disastrous consequences for poor households lacking the entitlements to acquire enough of their staple commodity.[41] Following the floods in 1988/89 and 1998/99, in contrast, rice prices rose by only 7.0 percent and 12.4 percent, respectively, in these months.

This difference in market price behavior is not explained by the size of the production shortfall. As shown in Table 3.8, in comparison with 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 played a major role in the price increase.

Ravallion (1985, 1990) provides econometric evidence that exaggerated reports of crop failure influenced traders' expectations and led to "excessive hoarding" of stocks.[42] 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. Government rice stocks were extremely low at the time of the floods (end-July 1974): only 27,000 tons, equivalent to

[40] The official death toll from the famine was 30,000 (Alamgir, 1980); unofficial reports were much higher. Sobhan (1979: 175) quotes an official figure of 27,000 and an upper nonofficial estimate of 100,000; Lifschultz (1979: 130) gives a figure of 50,000.

[41] Wheat prices also rose by 61.2 percent in the same period.

[42] In his time-series regressions on rice price formation, Ravallion uses the number of newspaper articles about crop shortages as a proxy for traders' expectations about future production shortfalls.

Table 3.8 Rice shortfalls, public stocks, and market prices in Bangladesh, 1974/75–1998/99

	1974/75	1979/80	1984/85	1988/89	1998/99
Rice production (million metric tons)					
Aus	3.00	2.78	2.78	2.86	1.62
Aman	6.29	7.11	7.93	6.86	7.74
Percent below trend	–8.5	–4.0	–0.1	–18.1	–18.0
Boro	2.29	2.48	3.91	5.83	10.55
Total rice production	11.58	12.37	14.62	15.55	19.91
Wheat production (million metric tons)	0.12	0.82	1.46	1.02	1.91
Total foodgrain production (million metric tons)	11.69	13.20	16.09	16.57	21.81
Per capita rice production (kilograms/person)	148.05	144.04	149.20	145.57	156.74
Aus and *aman* share of production (percent)	80.3	79.9	73.3	62.5	47.0
PFDS distribution, July–June (thousand metric tons)					
Total rice	131	702	399	690	530
Total wheat	1,597	1737	2163	2251	1,603
Targeted rice	4	7	6	167	386
Targeted wheat	157	490	905	1259	1,488
PFDS distribution, August–November (thousand metric tons)					
Total rice	43	263	201	231	216
Total wheat	616	725	891	700	223
Targeted rice	2	0	0	83	172
Targeted wheat	87	186	298	287	186
Food grain imports, July–June (thousand metric tons)					
Private sector rice	0	0	0	0	2,663
Public sector rice	267	759	695	61	393
Private sector wheat	0	0	0	0	805
Public sector wheat	2,030	2,023	1,898	2,075	1,603
Total availability (million metric tons)					
Rice	10.42	11.61	13.43	14.32	20.61
Wheat	1.70	2.35	3.27	3.12	3.87
Total foodgrains	12.12	13.96	16.69	17.44	24.48
Per capita availability (kilograms/person)					
Rice	133.26	135.15	136.99	134.07	162.31
Wheat	21.76	27.38	33.32	29.19	30.46
Foodgrains	155.03	162.53	170.31	163.26	192.77
National wholesale prices (Tk/kg)					
Rice: average, May–July	359	565	778	884	1237
Rice: average, August–November	568	565	807	946	1390
Percentage change	58.2	0.0	3.7	7.0	12.4
Wheat: average, May–July	256	335	438	538	857
Wheat: average, August–November	413	347	495	620	949
Percentage change	61.2	3.4	12.8	15.3	10.7
Public foodgrain closing stocks					
End of July stocks (thousand metric tons)					
Rice	27	170	101	710	438
Wheat	293	213	651	784	273
Total	320	383	752	1494	711
Average, August–November (thousand metric tons)					
Rice	21	327	223	621	359
Wheat	187	397	413	546	310
Total	208	723	636	1167	669
Average, August–November (kilograms/person)					
Rice	0.3	3.8	2.3	5.8	2.8
Wheat	2.4	4.6	4.2	5.1	2.4
Total	2.7	8.4	6.5	10.9	5.3
Foreign exchange reserves[a] (US$ million)	175	. . .	. . .	863	1,744
Mid-year population (million)	78.2	85.9	98.0	1,06.8	127.0

Sources: Food Planning and Monitoring Unit; Directorate General of Food, Marketing Information System; Bangladesh Bureau of Statistics; Department of Agricultural Marketing; and authors' calculations.

[a] End of June, previous fiscal year.

0.3 kilograms per person. Moreover, the Ministry of Food had great difficulties importing foodgrains because of a shortage of foreign exchange reserves, extremely high world foodgrain prices, and delays in U.S. food aid deliveries.[43] Because of the tight stock situation, total rice distribution during August through November was only 43,000 tons.

Osmani (1991) argues that larger public foodgrain stocks in 1979/80 and 1984/85 discouraged speculative market behavior and limited price rises following production shortfalls in those years. Public foodgrain stocks and distribution appear to have played a major role in 1988/89 as well. 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. Moreover, public foodgrain distribution from August through November in that year was 931,000 tons, 272,000 tons greater than in 1974/75.

Hossain (1990), however, presents evidence that, during the 1978–90 period, the government of Bangladesh overreacted to natural disasters by importing more foodgrain than needed, leading to an excessive build-up of stocks. Only about 50–60 percent of the additional imports were used to augment domestic supply in the year of the natural disaster, and the increased stocks and distribution in the years immediately following a disaster were associated with lower paddy prices for farmers. Three main factors contributed to overestimation of import requirements: a tendency of local government officials to overstate production losses in hopes of receiving more aid, a positive supply response of producers in subsequent seasons to higher prices, and lower consumer demand by farmers with reduced incomes. Thus, acquiring and holding additional stocks implied significant costs to the government and to farmers, as the additional imports were often purchased through commercial channels at a high price, extra storage costs were incurred, and market prices tended to be depressed in the year following a natural disaster.

Stocks in 1998/99 were significantly larger than in 1974/75 in the crucial August through November months: 669,000 tons, or 5.3 kilograms per person—twice the per capita stocks of 1974/75, though half those of 1988/89 (Figure 3.6). 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.[44] Moreover, the Ministry of Food made numerous efforts to increase its stocks through international and domestic procurement of grain through tenders, with little success. Nonetheless, markets were stabilized with fewer public stocks because of the continued flow of private sector imports in the months following the flood.[45]

Several factors suggest that the need for public stocks to avert famines in Bangladesh has considerably decreased since 1974. First, because of the stabilizing influence of *boro* production, total rice production was only 5.17 percent below trend in 1988/89 and was actually 0.08 percent above trend in 1998/99. Total rice production in 1974/75 was 1.82 percent below trend. 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, increased foodgrain availability, raised farmer incomes, and reduced prices.[46] Second, as shown above,

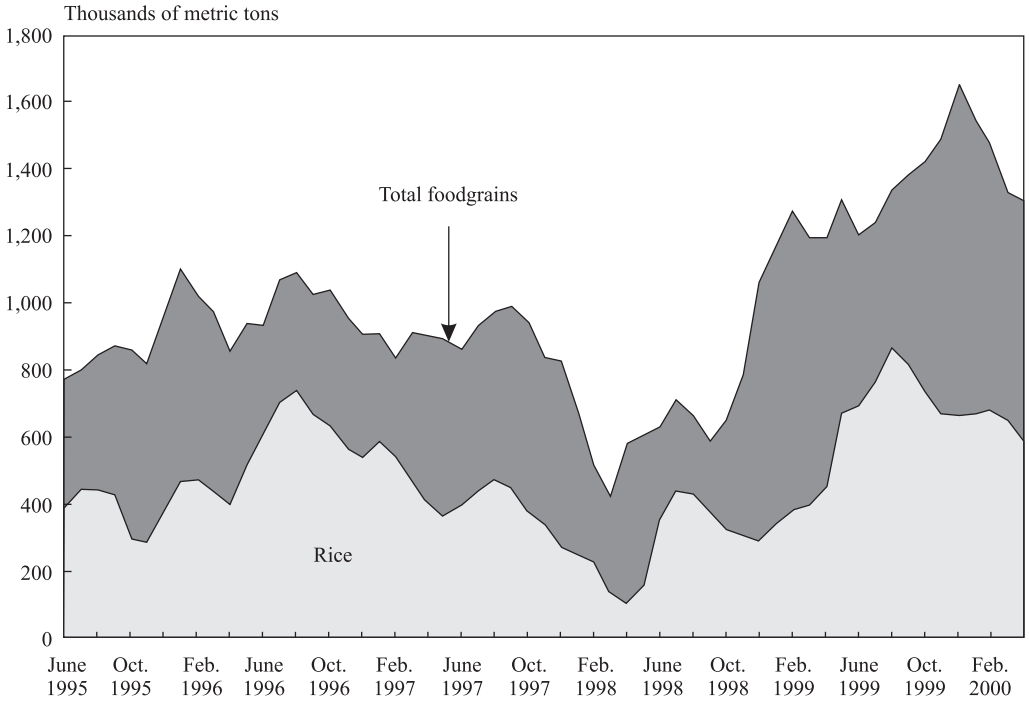
[43] Sobhan (1979) argues that the proximate cause of the famine in 1974 was the withholding of U.S. PL 480 food aid imports; a new agreement for food aid for 1973/74 was not reached until July 10, 1974, and grain was not shipped until October 1974. Contributing necessary conditions were the forces of the market (controlled by big farmers and traders) and the refusal of the Bangladesh government to reallocate available food stocks towards rural channels, such as Modified Rationing, and away from favored urban channels (through Statutory Rationing).

[44] The sharp fall in rice stocks in early 1998 following the drought-damaged 1997 *aman* crop was seen by policymakers as a cause of the sharp increase in prices in those months.

[45] Early assurances of food aid by donors may also have contributed to calming markets in Bangladesh.

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

Figure 3.6 Closing stocks of rice and total foodgrains in Bangladesh, 1995–2000



Source: Food Planning and Monitoring Unit, Ministry of Food.

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 much better developed than in 1988/89, and especially compared with 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, have been greatly eased through increased export earnings and the 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.

In addition, demand-side factors have increased the food security of Bangladesh. As pointed out by Hossain (1990), real per capita incomes and food consumption were substantially greater in 1990 than in 1974 (and had increased further by 1998), so that small decreases in availability need not have the disastrous consequences they had in 1974. Moreover, the expansion of the nonfoodgrain economy provides other employment opportunities for the rural poor when foodgrain production falters.

Summary

Foodgrain and price stability following the floods in 1998 was largely maintained through a combination of private sector imports (mainly from India) and subsequently a bumper *boro* harvest, rather than through increased public foodgrain distribution or large public stocks. Government distribution of foodgrains was only 631 tons above orig-

inally scheduled quantities in the last six months of 1998, compared with official estimates of more than 1 million tons of private sector rice imports from India in the same period.

Government policy nonetheless played an important role in ensuring the availability of food. The trade liberalization of the early 1990s permitted private sector imports and concrete measures encouraged private sector imports during 1998. Moreover, long-term policies of investment in infrastructure, agricultural research, and extension contributed to well-functioning markets and an expansion of *boro* rice production that reduced the time between major rice harvests in Bangladesh from 12 months to 6 months.

CHAPTER 4

Impact of the Floods on Agricultural Production, Employment, and Wealth

Almost all households in flooded regions of Bangladesh in September 1998 were affected either directly or indirectly. Many households lost standing crops, along with productive and valuable assets; others could not find employment that would otherwise have been available if the floods had not been so severe. In this chapter, we assess the impacts of the floods through loss of agricultural production (particularly for households' main crops), loss of other assets, and loss of income from labor market participation. Along with data by level of flood exposure, we present data on direct economic losses from the flood by household per capita expenditures, in order to show the varying effect of flood exposure on poor and nonpoor households.

Agricultural Production and Crop Losses

As noted in the previous chapter, farmers' choices of cropping patterns in Bangladesh are constrained by the timing and depth of flooding. In many of the low-lying areas of the country, a meter or more of water covers the land during the monsoon season every year, thus precluding any crop cultivation during that period. In a normal year, 41.0 percent of farmland cultivated (owned) by the farmers in our sample is covered by more than 90 centimeters of water during the monsoon season (Table 4.1). In Derai *thana* (Sunamganj district in northeast Bangladesh), 48 percent of the land is covered by more than 3 meters of water during the monsoon season. On this land, only one crop of *boro* rice, planted in November or December and harvested in March or April, is possible. Another 31 percent of the area cultivated in the sample survey was medium lowland and lowland, with average flood depth of 0.9 to 3.0 meters. Deepwater *aman* or *aus* crops are typically cultivated on this land during the monsoon season, with a crop of *boro* rice or wheat (on the medium lowland) often cultivated during the dry season (see Figure 4.1). On the medium highland and highland (the remaining 59 percent of the land cultivated by survey farmers), transplanted *aman* rice dominates the cropping pattern from the time of transplanting (normally around August) to harvest in November or December.

During the 1998 floods, floodwaters on sample farmers' fields were almost double their normal levels—137 centimeters compared with 73 centimeters. On medium highland, flood-

Table 4.1 Distribution of farmers' land by flood depth in a normal year and in 1998, by survey *thana*

	Flood depth in normal year (in centimeters)					
Thana	Highland (0)	Medium highland (0–90)	Medium lowland (90–180)	Lowland (180–200)	Very low land (> 300)	All
Derai (Sunamganj)						
Share of farmland	0.27	0.02	0.07	0.15	0.48	1.00
Average normal flood depth (cm)	—	54.15	133.39	214.74	484.92	221.80
Average 1998 flood depth (cm)	16.92	138.76	223.72	297.75	657.94	314.50
Difference	16.92	84.61	90.33	83.00	173.01	92.70
Madaripur (Madaripur)						
Share of farmland	0.26	0.21	0.28	0.18	0.08	1.00
Average normal flood depth (cm)	—	51.27	110.97	223.84	426.44	98.77
Average 1998 flood depth (cm)	15.56	149.90	209.84	309.03	452.33	163.44
Difference	15.56	98.62	98.87	85.19	25.89	64.67
Mohamedpur (Magura)						
Share of farmland	0.69	0.19	0.12	0.00	0.00	1.00
Average normal flood depth (cm)	—	44.77	100.48	182.76	418.83	23.16
Average 1998 flood depth (cm)	17.70	95.54	172.08	253.83	418.83	53.04
Difference	17.70	50.77	71.60	71.07	—	29.88
Muladi (Barisal)						
Share of farmland	0.32	0.40	0.24	0.04	0.01	1.00
Average normal flood depth (cm)	—	57.10	105.95	189.11	380.75	56.73
Average 1998 flood depth (cm)	26.04	147.21	205.94	293.03	494.98	129.82
Difference	26.04	90.11	99.99	103.92	114.23	73.09
Saturia (Manikganj)						
Share of farmland	0.39	0.28	0.25	0.07	0.01	1.00
Average normal flood depth (cm)	—	46.75	115.77	205.24	357.91	56.95
Average 1998 flood depth (cm)	25.53	150.13	205.61	292.27	456.90	125.21
Difference	25.53	103.38	89.84	87.03	99.00	68.26
Shibpur (Narshingdi)						
Share of farmland	0.52	0.17	0.17	0.09	0.05	1.00
Average normal flood depth (cm)	—	46.75	124.02	222.10	404.68	60.19
Average 1998 flood depth (cm)	24.87	117.40	198.53	290.64	624.43	112.89
Difference	24.87	70.65	74.52	68.53	219.75	52.70
Sharasti (Chandpur)						
Share of farmland	0.28	0.08	0.49	0.13	0.01	1.00
Average normal flood depth (cm)	—	55.25	116.73	206.47	472.13	90.24
Average 1998 flood depth (cm)	30.67	151.70	215.13	293.98	553.36	166.92
Difference	30.67	96.46	98.40	87.50	81.23	76.68
Total						
Share of farmland	0.39	0.20	0.22	0.09	0.10	1.00
Average normal flood depth (cm)	—	51.25	113.11	212.69	461.51	73.28
Average 1998 flood depth (cm)	22.25	138.97	205.86	297.85	607.80	136.81
Difference	22.25	87.73	92.75	85.16	146.29	63.53
Total land available (hectares)	116.45	61.80	67.09	26.70	30.35	302.38

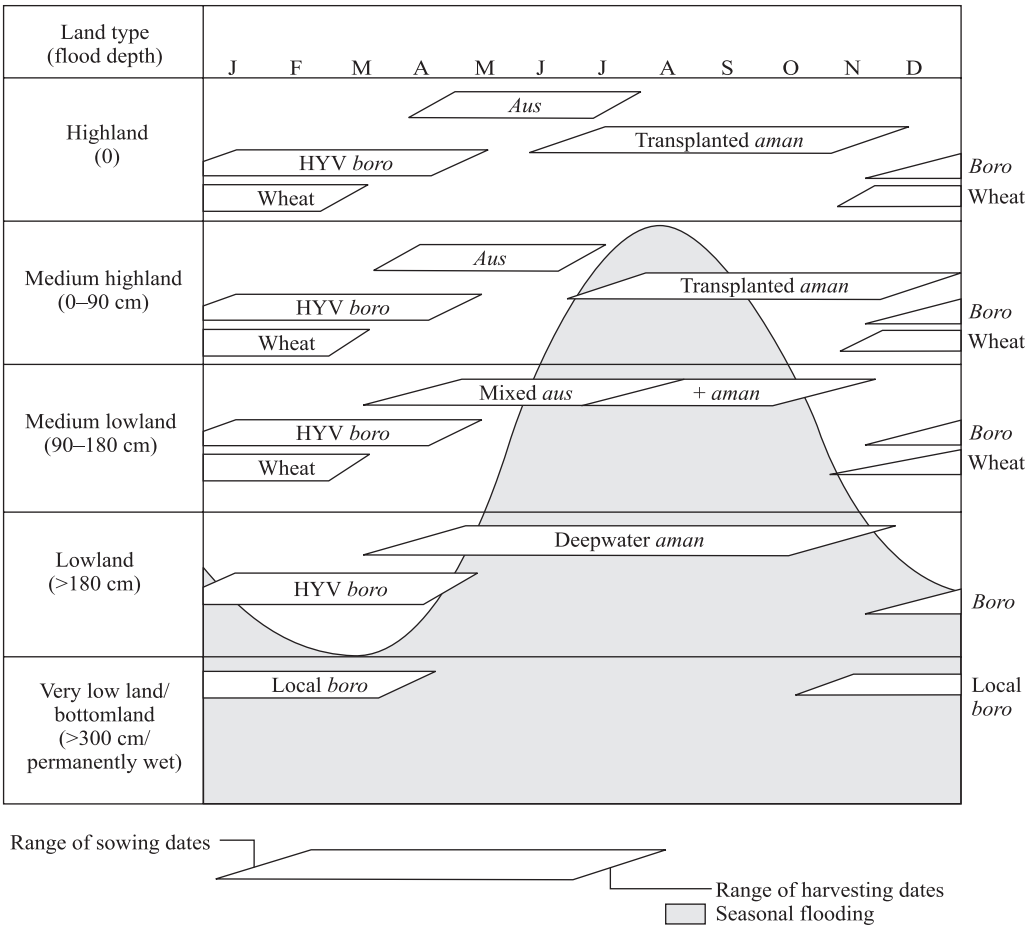
Source: IFPRI-FMRSP, Bangladesh Flood Impact Survey, 1998–1999.

Note: The district name of the *thana* is in parentheses.

waters were on average 88 centimeters higher than in normal years and even highland fields that normally are not flooded were covered by an average of 22 centimeters of water. Flooding was especially severe in the lowlands in Derai, where the average flood depth was 6.58 meters, 1.73 meters higher than average.

This severe flooding led to substantial crop losses, especially to the *aus* and *aman* crops (Table 4.2): 69 percent of *aus* production, 82 percent of deepwater (broadcast)

Figure 4.1 Bangladesh crop calendar and seasonal flooding



Source: Khan 1999.
Notes: Except for wheat, all names refer to rice crops. HYV = high-yielding variety.

aman, and 91 percent of transplanted *aman* was lost because of the floods, representing 24 percent of the total value of anticipated agricultural production for the year.[47] Overall, rice crop losses accounted for over half of total agricultural losses, with vegetables (25 percent) and fibers (19 percent) accounting for most of the remaining losses.

About 70 percent of households in our sample were engaged in some form of agricultural production in the 12 months prior to the survey, and their average agricultural production was Tk 8,277 (Table 4.3). In the sample, 52 percent of all households cultivated foodgrains (rice and wheat), although only 38 percent of households actually produced a crop.

The average crop loss for transplanted *aman* and *aus* crops was nearly constant across flood exposure category (moderate, severe, and very severe), with essentially all flood-exposed households suffering nearly total losses to transplanted *aman.* The average crop loss for deepwater *aman* varied more substantially, ranging from 56 to 94 percent across flood-exposed households, in large part because it is not cultivated on the very low lands in Derai and other *thana*

[47] Official unpublished Bangladesh Bureau of Statistics *thana*-level *aman* production estimates for 1998/99 are broadly consistent with the survey figures. Six of the *thanas* reported total failure of *aman* production, while the seventh (Shibpur *thana* in Narsingdi district) reported *aman* production down by 80 percent compared with 1996/97.

Table 4.2 Aggregate area, production, and loss of crops of sample farms

Crops	Area planted (hectares)	Production value (Tk thousand)	Value lost (Tk thousand)	Loss (percent)
Transplanted *aman*	37.9	119.6	1,202.6	91.0
Deepwater *aman*	23.6	101.0	451.4	81.7
Aus	27.3	176.3	383.4	68.5
Boro	19.0	920.6	160.4	14.8
Total rice	107.7	1,317.5	2,197.9	62.5
Wheat	7.4	247.0	—	—
Fibers	25.3	477.3	778.2	62.0
Vegetables	140.4	1,735.4	1,007.8	36.7
Other	32.7	524.0	45.1	7.9
Total	312.8	4,301.1	4,029.0	48.4

Source: IFPRI-FMRSP, Bangladesh Flood Impact Survey, 1998–1999.

where households were nonetheless severely flooded. Overall crop losses were still broadly similar for all farm households that were exposed to the flood, ranging from 42 to 62 percent of expected production. Crop losses for farm households not exposed to the floods were only 23 percent of expected production, however.[48]

Only 19 percent of households sampled grew fibers (jute and sugarcane), but average losses were high (62 percent). Overall, 26 percent of farmers who cultivated vegetables suffered losses to their vegetable crops, but average losses were only 37 percent. One reason for the high percentage of farmers growing vegetables and the relatively low percentage with flood losses was that many farmers decided to utilize their cropland for vegetable production just after the floodwaters receded, when it was too late for paddy cultivation. Price incentives appeared to have played a role here, as well, as the prices of vegetables went up during flood period, especially in the flood-affected areas. Within a few months, however, the price of vegetables declined as market supply increased.

Table 4.4 reports the values of losses of agricultural crop production of sample producing households by size of farm and flood exposure (again excluding the forgone value of *aman* cultivation when no crop was transplanted). Households with smaller farms did not appear to suffer greater percentage losses than households with larger farms. In fact, percentage production losses were highest for medium-sized farms (0.2–0.6 hectares) and very large farms (1.0 hectares and above). Note, too, there is no correlation between severity of household flood exposure and the size of landholding. The Spearman rank correlation coefficient between flood exposure and quintiles for 757 households is found to be very small and insignificant, further evidence that the severity of flooding was not significantly different for the poor than for the rich.

Ownership and Loss of Assets

All households in the sample reported ownership of some type of assets, such as cattle, poultry, and other tangible assets.[49] In addition to the losses to crops, 55 percent of the

[48] Note, though, that, since our flood exposure variable is based on measures of flooding at the home, the 70 percent of households "not exposed to the flood" that cultivated crops still suffered significant crop losses.

[49] Inexpensive agricultural assets include plows, husking mills (diesel operated), and other similar items. Valuable agricultural assets include goods such as power tillers, shallow pumps, deep tubewells, threshing machines, and electric husking mills. Cheap household assets include metal cooking pots and handlooms. Valuable household assets include items such as sewing machines and hand tubewells. The data related to number of animals in the livestock category were obtained by weighting younger individuals as a fraction of adult animals.

Table 4.3 Average area, production, and loss of crops, by flood exposure

Main crops	Not exposed	Flood exposure			All
		Moderate	Severe	Very severe	
Transplanted *aman*					
Crop growers (% of households)	30.9	32.1	38.6	24.4	31.8
Value of production (Tk/farm household)	595	995	225	156	485
Average land planted to crop (hectares/household)	0.10	0.23	0.14	0.20	0.16
Average production loss (Tk/farm household)	3,060	6,500	5,357	4,561	4,990
Production loss (%)	82.8	86.7	96.0	96.7	91.0
Deepwater *aman*					
Crop growers (% of households)	19.8	21.8	24.2	14.3	20.2
Value of production (Tk/farm household)	893	502	373	1078	660
Average land planted to crop (hectares/household)	0.09	0.17	0.20	0.16	0.15
Average production loss (Tk/farm household)	1,206	7,701	3,204	1,342	2,951
Production loss (%)	57.5	93.9	89.6	55.5	81.7
Aus					
Crop growers (% of households)	22.1	21.8	23.7	12.5	20.3
Value of production (Tk/farm household)	1,714	1,213	815	496	1,145
Average land planted to crop (hectares/household)	0.09	0.26	0.20	0.17	0.18
Average production loss (Tk/farm household)	1,021	3,579	2,506	2,699	2,490
Production loss (%)	37.3	74.7	75.5	84.5	68.5
Boro					
Crop growers (% of households)	21.2	17.0	14.5	8.9	15.7
Value of production (Tk/farm household)	7,926	11,733	4,476	6,212	7,736
Average land planted to crop (hectares/household)	0.13	0.18	0.16	0.16	0.15
Average production loss (Tk/farm household)	1,682	140	1,712	820	1,348
Production loss (%)	17.5	1.2	27.7	11.7	14.8
Wheat					
Crop growers (% of households)	20.3	13.9	13.0	8.3	14.3
Value of production (Tk/farm household)	2,596	2,580	1,760	1,850	2,284
Average land planted to crop (hectares/household)	0.07	0.05	0.07	0.07	0.07
Average production loss (Tk/farm household)	—	—	—	—	—
Production loss (%)	—	—	—	—	—
All cereals (all rice and wheat)					
Crop growers (% of households)	50.2	52.1	59.9	42.3	51.5
Value of production (Tk/farm household)	5,842	5,841	2,084	2,278	3,998
Average land planted to crop (hectares/household)	0.22	0.39	0.30	0.27	0.29
Average production loss (Tk/farm household)	3,517	8,773	6,152	4,059	5,636
Production loss (%)	37.4	60.0	74.7	64.1	58.4
Fibers (sugarcane and jute)					
Crop growers (% of households)	28.1	20.6	11.6	13.7	18.8
Value of production (Tk/farm household)	1,944	4,554	7,436	1,104	3,361
Average land planted to crop (hectares/household)	0.12	0.28	0.14	0.21	0.18
Average production loss (Tk/farm household)	189	21,758	486	660	5,480
Production loss (%)	8.9	82.7	6.1	37.4	62.0
Vegetables					
Crop growers (% of households)	52.5	53.9	58.9	47.6	53.5
Value of production (Tk/farm household)	4,865	3,497	5,542	2,419	4,285
Average land planted to crop (hectares/household)	0.30	0.50	0.33	0.27	0.35
Average production loss (Tk/farm household)	425	3,111	5,411	287	2,488
Production loss (%)	8.0	47.1	49.4	10.6	36.7
Other					
Crop growers (% of households)	36.4	41.8	52.2	36.3	41.9
Value of production (Tk/farm household)	1,986	2,211	1,242	1,318	1,653
Average land planted to crop (hectares/household)	0.11	0.16	0.08	0.08	0.10
Average production loss (Tk/farm household)	93	412	68	25	142
Production loss (%)	4.5	15.7	5.2	1.9	7.9
Total					
Crop growers (% of households)	72.4	68.5	78.7	61.3	70.8
Value of production (Tk/farm household)	9,343	9,920	7,651	4,476	8,015
Average land planted to crop (hectares/household)	0.48	0.87	0.55	0.48	0.58
Average production loss (Tk/farm household)	2,870	15,925	8,846	3,183	7,517
Production loss (%)	23.4	61.6	53.6	41.6	48.4
Sample size					
Number of farm households	157	113	163	103	536
Total number of households	217	165	207	168	757

Source: IFPRI-FMRSP, Bangladesh Flood Impact Survey, 1998–1999.

Table 4.4 Producing households and loss of agricultural production, by farm size and flood exposure (percent)

	Not exposed		Exposed		All	
Farmland available (hectares)	**Farm households**	**Production loss**	**Farm households**	**Production loss**	**Farm households**	**Production loss**
0–0.02	24.20	13.6	19.53	37.2	20.90	29.4
0.02–0.2	21.66	18.1	26.91	30.3	25.37	27.9
0.2–0.6	35.03	14.9	34.83	58.0	34.89	47.9
0.6–1.0	10.19	27.1	11.08	39.5	10.82	34.8
1.0+	8.92	10.9	7.65	56.7	8.02	48.8
Total	100.00	23.4	100.00	55.6	100.00	48.4
Number of farm households	157		379		536.00	
Percentage of farm households	72.35		70.19		70.81	
Sample size	217		540		757	

Source: IFPRI-FMRSP, Bangladesh Flood Impact Survey, 1998–1999.

Note: Percentage loss is calculated as losses as a share of actual production plus losses.

households surveyed suffered damage to or destruction of assets, which reduced their household wealth as well as future productive capacity.

Almost all households reported having at least one house (main house). More than 80 percent of the houses were roofed with tiles, tin, or concrete, and the roofs of the remaining houses (18 percent) were covered with bamboo, straw (*chhan*), leaves, or jute sticks. Less than half of all households owned trees, a potentially important source of food as well as of income (del Ninno and Roy 1999b).

In the sample area, 47.6 percent of households reported owning cattle and more than 76 percent owned chickens. Few households in the sample owned more than these basic assets, though. Only 15 percent owned a radio and one-fourth of rural households possessed either a radio or a clock. Although 40 percent of the households owned small agricultural equipment, only 3.43 percent owned valuable agricultural assets such as irrigation equipment.

The pattern of ownership of assets by the level of welfare and the ownership of land shows that richer households own more assets in general, particularly the more valuable assets such as transport vehicles and jewelry. Similarly, households that own more land tend to have more trees, cattle, chickens, and other agricultural assets. About 8 percent of households owning large trees belong to the largest landholding group and they have on average 20 large trees, compared with the 9 large trees of the households with the smallest landholdings (less than 0.02 hectares). Similarly, large landowners owned an average of 4 cattle and 10 chickens, compared with 1.5 and 5.6, respectively, for small landowners.

Table 4.5 shows the losses of various tangible assets by severity of flood exposure. For the 55 percent of households that lost assets, the average loss was Tk 6,936, equivalent to 16 percent of the pre-flood total value of assets.

The value of the losses of assets and the proportion to its value varied widely according to asset, however. The most serious losses were for housing. In all, 47 percent of households suffered damage or loss to housing, with the average loss equal to Tk 5,675, or 59 percent of pre-flood housing value. The floods also caused serious damage to large trees: 17 percent of households lost tress with an average value of Tk 5,137. Nearly 15 percent of households lost chickens, though the average value of the loss was only Tk 142. Note that less than 1 percent of households lost stocks of cereals.

The more severe the level of flood exposure, the larger the proportion of households suffering damage to their assets—78 percent

Table 4.5 Households' loss of assets, by asset type and severity of flood exposure

Type of asset	Not exposed	Flood exposure			All
		Moderate	Severe	Very severe	
Housing (% of households that lost assets)	7.8	49.7	64.3	74.4	47.2
Average value of loss (Tk)	2,509	5,541	5,649	6,221	5,675
Share of pre-flood value (%)	56.3	60.0	59.8	59.6	58.8
Productive assets (% of households that lost assets)	9.7	23.6	27.1	28.6	21.7
Average value of loss (Tk)	431	1,300	942	1,000	979
Share of pre-flood value (%)	15.2	14.4	15.7	16.1	15.3
Cattle (% of households that lost assets)	0.5	7.3	7.2	5.4	4.9
Average value of loss (Tk)	1,750	3,406	2,582	3,457	3,040
Goats/sheep (% of households that lost assets)	0.9	2.4	1.9	2.4	1.8
Average value of loss (Tk)	850	574	588	500	596
Chickens (% of households that lost assets)	7.8	15.8	17.4	20.8	14.8
Average value of loss (Tk)	184	159	115	142	142
Ducks (% of households that lost assets)	1.4	6.7	5.3	7.7	5.0
Average value of loss (Tk)	166	75	206	251	180
Agricultural tools (% of households that lost assets)	0.0	1.2	5.3	7.1	3.3
Average value of loss (Tk)	—	13	26	26	25
Agricultural equipment (% of households that lost assets)	0.0	0.0	0.0	1.2	0.3
Average value of loss (Tk)	—	—	—	2,216	2,216
Fishing equipment (% of households that lost assets)	0.5	1.8	2.4	1.8	1.6
Average value of loss (Tk)	1,980	793	1,026	239	850
Transport vehicles (% of households that lost assets)	0.0	0.0	0.0	0.6	0.1
Average value of loss (Tk)	—	—	—	1,200	1,200
Liquid assets (% of households that lost assets)	6.9	21.2	24.2	23.8	18.5
Average value of loss (Tk)	4,692	3,094	2,906	8,428	4,722
Share of pre-flood value (%)	17.2	17.6	17.8	17.3	17.5
Large trees (% of households that lost assets)	6.9	18.8	21.3	21.4	16.6
Average value of loss (Tk)	4,692	3,427	3,144	9,230	5,137
Jewelry(% of households that lost assets)	0.0	2.4	4.8	6.5	3.7
Average value of loss (Tk)	—	158	567	308	302
Consumer durables (motorcycles) (% of households that lost assets)	0.5	0.0	0.0	0.6	0.3
Average value of loss (Tk)	500	—	—	1,000	750
Share of pre-flood value (%)	2.1	2.6	1.0	1.1	1.8
Domestic assets (% of households that lost assets)	0.0	6.1	15.5	22.0	10.4
Average value of loss (Tk)	—	311	177	207	208
Share of pre-flood value (%)	8.5	5.1	5.4	5.6	6.2
Cereal stocks (% of households that lost assets)	0.0	0.0	1.9	1.2	0.8
Average value of loss (Tk)	—	—	346	1,605	766
Small household items (% of households that lost assets)	0.0	5.5	9.7	13.7	6.7
Average value of loss (Tk)	—	205	436	136	265
Large household items (% of households that lost assets)	0.0	3.6	4.3	7.1	3.8
Average value of loss (Tk)	—	289	94	93	145
Other assets (% of households that lost assets)	0.0	0.0	0.0	3.6	0.8
Average value of loss (Tk)	—	—	—	2,182	2,182
Share of pre-flood value	0.6	0.4	0.3	0.4	0.4
Total (% of households that lost assets)	18.9	60.6	69.1	78.0	54.8
Average value of loss (Tk)	2,990	6,164	6,679	9,042	6,936
Share of pre-flood value (%)	7.1	11.8	16.5	23.2	16.0
Number of households	217	165	207	168	757

Source: IFPRI-FMRSP, Household Survey 1998.

Table 4.6 Flood-exposed households' loss of assets, by asset type and expenditure quintile

Type of asset	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	All
Housing (% of households that lost assets)	67.26	66.37	62.26	57.43	60.75	62.96
Average value of loss (Tk)	4,924	4,713	7,242	6,689	5,994	5,833
Share of pre-flood value	60.37	55.13	69.39	62.99	54.84	59.79
Productive assets (% of households that lost assets)	24.78	29.20	27.36	26.73	24.30	26.48
Average value of loss (Tk)	1,020	1,291	1,068	940	921	1,059
Share of pre-flood value	20.40	19.14	13.88	15.71	13.03	15.33
Cattle (% of households that lost assets)	7.08	9.73	6.60	4.95	4.67	6.67
Average value of loss (Tk)	2,601	3,264	2,989	4,012	2,604	3,075
Goats/sheep (% of households that lost assets)	4.42	0.88	2.83	—	2.80	2.22
Average value of loss (Tk)	425	450	900	—	457	554
Chickens (% of households that lost assets)	15.93	22.12	14.15	21.78	15.89	17.96
Average value of loss (Tk)	130	125	110	116	209	136
Ducks (% of households that lost assets)	7.96	7.08	8.49	5.94	2.80	6.48
Average value of loss (Tk)	316	128	182	85	113	182
Agricultural tools (% of households that lost assets)	4.42	6.19	3.77	5.94	2.80	4.63
Average value of loss (Tk)	24	21	14	20	57	25
Agricultural equipment (% of households that lost assets)	—	—	—	0.99	0.93	0.37
Average value of loss (Tk)	—	—	—	1,431	3,000	2,216
Fishing equipment (% of households that lost assets)	0.88	0.88	3.77	0.99	3.74	2.04
Average value of loss (Tk)	300	900	955	712	623	748
Transport vehicles (% of households that lost assets)	—	0.88	—	—	—	0.19
Average value of loss (Tk)	—	1,200	—	—	—	1,200
Liquid assets (% of households that lost assets)	19.47	32.74	16.98	19.80	26.17	23.15
Average value of loss (Tk)	3,445	4,866	1,855	3,385	8,350	4,726
Share of pre-flood value	11.68	17.69	9.98	14.91	24.37	17.57
Large trees (% of households that lost assets)	7.70	27.43	16.04	17.82	23.36	20.56
Average value of loss (Tk)	3,727	5,662	1,824	3,607	9,236	5,197
Jewelry (% of households that lost assets)	5.31	7.96	3.77	4.95	4.67	5.37
Average value of loss (Tk)	121	507	304	391	308	345
Domestic assets (% of households that lost assets)	14.16	20.35	6.60	14.85	16.82	14.63
Average value of loss (Tk)	85	112	168	210	453	208
Share of pre-flood value	6.82	6.25	5.45	5.19	4.62	5.34
Cereal stocks (% of households that lost assets)	—	—	0.94	1.98	2.80	1.11
Average value of loss (Tk)	—	—	78	69	1,459	766
Small household items (% of households that lost assets)	9.73	13.27	4.72	9.90	8.41	9.26
Average value of loss (Tk)	132	85	453	331	409	240
Large household items (% of households that lost assets)	4.42	7.08	0.94	6.93	5.61	5.00
Average value of loss (Tk)	86	138	200	76	244	138
Other assets (% of households that lost assets)	0.88	0.88	2.83	0.99	—	1.11
Average value of loss (Tk)	200	1,200	3,888	25	—	2,182
Share of pre-flood value	0.37	0.45	0.28	0.22	0.45	0.36
Total (% of households that lost assets)	72.57	69.91	68.87	65.35	69.16	69.26
Average value of loss (Tk)	5,868	7,340	7,605	7,337	8,858	7,369
Share of pre-flood value	30.51	23.08	18.51	15.30	11.05	16.90
Number of households	113	113	106	101	107	540

Source: IFPRI-FMRSP, Household Survey 1998.

of the very severely flood-exposed households and 69 percent of the severely affected households lost assets worth on average Tk 9,042 and Tk 6,679, respectively. By comparison, only 19 percent of households defined as not exposed to the floods suffered loss of assets, and their average loss was only Tk 2,990.

The percentages of households reporting loss of assets were similar for poorer households and richer households (Table 4.6). For the 73 percent of households in the first expenditure quintile who lost assets, the average loss was Tk 5,868, compared with Tk 8,858 for the 69 percent of households in the top quintile who suffered losses.

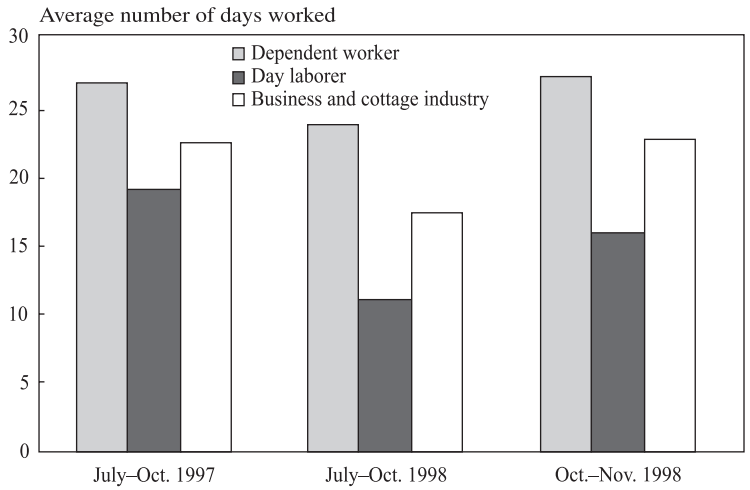
Poor households' losses were concentrated mainly in housing and productive assets (such as cattle and poultry); richer households' losses included large trees as well as housing. Note also that losses as a proportion of pre-flood value were noticeably higher for poor households (in quintiles 1 and 2) than for richer households (quintile 5). Thus, although richer households lost valuable assets, many poorer households experienced a bigger relative shock as a result of the floods because they had fewer assets to begin with.

Labor Participation and Earnings

The floods disrupted economic activities as well as destroying crops and assets. Agricultural employment, transport, and the nonfarm economy were all affected, not only while the floodwaters covered the land, but for several months afterward.

As shown in Figure 4.2 and Table 4.7, the average monthly days worked fell in the period of the floods and afterwards increased to the same level as 12 months earlier for all workers except day laborers.[50] The decline in employment during the floods was not very severe for dependent workers or those employed in cottage industries. For example, dependent workers' employment fell from 27 days per month in 1997 to 24 days per month in July through October 1998. By October–November 1998, they were again employed an average of 27 days per month. Day laborers were more severely affected: their employment fell sharply from 19 days per month in 1997 to only 11 days per month in July through October, 1998. By October–November 1998, employment had increased to an average of 16 days per month, still 3 days per month less than the average for July through October 1997.

Figure 4.2 Average number of days in the current main job in the periods before, during, and after the floods



Source: IFPRI-FMRSP, Household Survey 1998

Similarly, wage earnings also fell in the period of the floods and had not recovered to 1997 levels by October–November 1998. For dependent workers, average monthly wage earnings during July–October 1998 were 16.5 percent below their average monthly earnings one year earlier. For day laborers, average monthly earnings in July–October 1998 were 46 percent below those in the same months in 1997, and in October–November 1998 were still 18 percent below the 1997 levels. Female earnings were lower than male earnings in all labor categories, but the differences over the two periods were less pronounced than the variations in male monthly income.

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 had fewer work days, but most workers found at least some employment. Many people, however, were neither gainfully employed nor actively searching for

[50] Working people have been classified as dependent workers, day laborers, business and cottage industry entrepreneurs (those that are engaged in self-employment activities), farmers, and unpaid family laborers. The main difference between dependent workers and day laborers is job regularity. Dependent workers are hired for a fixed amount of time. Day laborers are hired for the day and are found to be multi-occupational, being engaged in agriculture and nonfarm activities such as commercial, transport, and industrial activities.

Table 4.7 Average monthly earnings of workers in current main job in the periods before, during, and after the floods

Worker category by gender	July–October 1997			July–October 1998			October–November 1998		
	Number of participants	Earnings (Tk)	Number of days worked	Number of participants	Earnings (Tk)	Number of days worked	Number of participants	Earnings (Tk)	Number of days worked
Dependent worker									
Male	93	7,486	27.0	91	5,645	23.4	91	2,877	27.5
Female	17	1,674	27.2	16	2,439	26.4	16	1,325	26.8
Total	110	6,587	27.0	107	5,166	23.9	107	2,645	27.4
Day laborer									
Male	235	1,160	19.1	234	666	11.1	235	950	15.8
Female	11	723	20.3	11	357	11.0	11	590	16.7
Total	246	1,140	19.2	245	651	11.1	246	933	15.9
Business and cottage industry									
Male	101	2,296	23.1	101	1,797	17.8	101	1,931	23.2
Female	6	383	15.7	6	258	12.7	7	407	17.7
Total	107	2,189	22.6	107	1,710	17.48	108	1,832	22.8

Source: IFPRI-FMRSP, Household Survey 1998.

jobs in the months immediately following the floods.

Table 4.8 and Figure 4.3 show how the participation rate in the labor market varied by age and sex. The labor participation rate has been defined as the ratio of the number of persons who are either employed or searching for employment to the total population in the 10–65 age group.[51] This participation rate represents the percentage of economically active persons (who include the employed, those looking for work, and the discouraged) in the population of aged 10–65 years.

We found that the aggregate labor participation rate was very low (41 percent). On average, participation rates for males were higher—67 percent, compared with only 14 percent for females. The highest participation rates were for males between 25 and 60 years of age: 84–94 percent. Female participation rates for those working or actively looking for jobs were low, 15–19 percent, even for females between 25 and 60 years of age.

Open unemployment was virtually nonexistent (below 3 percent), and it appears that, in the post-flood period, people in rural Bangladesh were willing to work more and increase their incomes, especially given that about one-third of the population are very poor and consumed fewer than 1,800 calories per capita per day (del Ninno and Roy 1999b). In this situation of low unemployment, yet low participation, among some age cohorts, it is important to understand why people did not participate in the labor market.

Table 4.9 shows that males' main reason for not participating was going to school, es-

Table 4.8 Labor participation rates, by age and gender, November 1998

Age categories	Participation rate (%)			Number of persons
	Male	Female	All	
10–14	4.3	5.3	10.0	623
15–24	54.5	14.1	34.0	698
25–34	89.8	14.8	50.3	603
35–54	94.2	18.6	60.8	828
55–60	83.9	18.9	54.0	161
61–65	74.5	15.0	56.7	67
Total	66.8	13.8	41.3	2,980

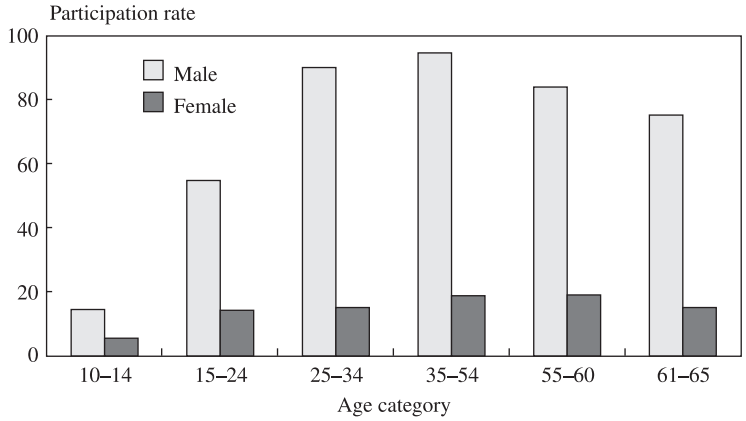
Source: IFPRI-FMRSP, Household Survey 1998.

Note: The participation rate is defined as the percentage of persons working or searching for work.

[51] We also used an alternative definition of labor participation, which included discouraged workers. Economically discouraged workers were defined as those who were not employed and were not searching for a job because they believed there were no jobs available. The results did not show any difference.

pecially in the 10–14 and 15–24 age groups (86 and 77 percent, respectively). Of the girls aged 10–14 years, 80 percent did not participate in the labor force because of schooling. Older women were mostly engaged in housekeeping activities, especially in the 25–60 age groups. Probit regression analysis shows that primary education has a positive impact on participation in the labor market, but the values of household-owned land and other productive assets decrease the probability of participation. Coefficients on village-level agriculture flood exposure dummy variables indicate that the floods had an overall negative impact on labor market participation. The low participation rate, made worse in villages where agriculture was severely exposed to the flood, highlights how critical was the loss of working days suffered during the period of the floods, especially for households that relied more on selling their labor as a main source of income.

Figure 4.3 Labor participation rates, by age and gender, November 1998



Source: IFPRI-FMRSP, Household Survey 1998.

Labor Status and Earnings

Workers in rural Bangladesh are engaged mostly in unskilled manual jobs, which can be performed with little training. More than one-third of the rural workers in our sample were day laborers (Table 4.10). Dependent

Table 4.9 Nonparticipants' reasons for not looking for a job

	Reason for not looking for job (%)							
Age categories	No need	No jobs	Sick	Student	Housekeeping	Other	Total	Number
All								
10–14	0.6	1.3	0.2	82.9	10.9	4.2	100	479
15–24	1.7	1.2	0.7	42.0	49.5	4.9	100	412
25–34	1.1	0.4	0.7	3.7	91.1	3.0	100	271
35–54	2.6	1.0	2.6	0.7	92.5	0.7	100	308
55–60	3.0	—	10.6	—	77.3	9.1	100	66
61–65	7.4	—	22.2	—	66.7	3.7	100	27
Total	1.6	1.0	1.7	37.2	54.8	3.7	100	1,563
Male								
10–14	0.9	1.7	—	85.8	5.6	6.0	100	233
15–24	2.3	2.3	0.8	76.5	9.1	9.1	100	132
25–34	5.3	—	5.3	31.6	15.8	42.1	100	19
35–54	30.0	5.0	20.0	—	40.0	5.0	100	20
55–60	16.7	—	25.0	—	50.0	8.3	100	12
61–65	—	—	33.3	—	66.7	—	100	12
Total	3.3	1.9	3.0	71.7	11.7	8.4	100	428
Female								
10–14	0.4	0.8	0.4	80.1	15.9	2.4	100	246
15–24	1.4	0.7	0.7	25.7	68.6	2.9	100	280
25–34	0.8	0.4	0.4	1.6	96.8	—	100	252
35–54	0.7	0.7	1.4	0.7	96.2	0.4	100	288
55–60	—	—	—	—	83.3	9.3	100	54
61–65	13.3	—	—	—	66.7	6.7	100	15
Total	1.0	0.6	24.2	24.2	71.1	1.9	100	1,135

Source: IFPRI-FMRSP, Household Survey 1998.

Table 4.10 Distribution of engaged persons, by age and job category

	Main current type of work (%)						
Age categories	**Dependent**	**Daily laborer**	**Own business**	**Own farm**	**Unpaid**	**Total**	**Number**
All							
10–14	24.6	15.8	15.8	21.1	22.8	100	57
15–24	26.4	28.2	13.6	15.5	16.4	100	220
25–34	19.1	36.2	24.2	12.3	8.2	100	293
35–54	12.5	38.9	23.5	19.2	5.9	100	489
55–60	6.0	25.3	20.5	37.4	10.8	100	83
61–65	—	18.2	21.2	57.6	3.0	100	33
Total	16.5	33.5	21.2	19.2	9.5	100	1,175
Male							
10–14	27.9	16.3	16.3	25.6	14.0	100	43
15–24	26.0	32.4	12.7	19.1	9.8	100	173
25–34	19.3	39.0	24.9	14.1	2.8	100	249
35–54	12.1	41.1	24.4	21.5	1.0	100	423
55–60	6.9	27.4	21.9	42.5	1.4	100	73
61–65	—	16.1	22.6	61.3	—	100	31
Total	16.2	36.2	21.9	22.2	3.5		992
Female							
10–14	14.3	14.3	14.3	7.1	50.0	100	14
15–24	27.7	12.8	17.0	2.1	40.4	100	47
25–34	18.2	20.5	20.5	2.3	38.6	100	44
35–54	15.2	24.2	18.2	4.6	37.9	100	66
55–60	—	10.0	10.0	—	80.0	100	10
61–65	—	50.0	—	—	50.0	100	2
Total	18.0	19.1	17.5	3.3	42.1		183

Source: IFPRI-FMRSP, Household Survey 1998.

workers represented only 16 per cent of employed persons. Forty percent of workers were self-employed in November 1998, the majority of them engaged in nonfarm activities; one-fifth of all rural employed persons worked on their own farm. The figures are quite different for women: more than 42 percent were unpaid family workers.

Dependent workers in the sample had relatively higher levels of education than others, and 14 percent of them had completed 10 or more years of schooling. Those employed in their own business were better educated than those engaged on their own farm. The proportion of uneducated workers employed as day laborers was very high compared with those in other labor status categories. About half of the day laborers were employed in agricultural work. The manufacturing sector absorbed more than one-fourth of day laborers, followed by construction (including earthworks and off-farm). The average daily wage rate was higher in construction work, transport, and trade jobs (del Ninno and Roy 1999b).

A large majority of dependent workers were hired in the private sector. The government and government projects absorbed one-fourth of dependent workers. The proportionate use of dependent workers was larger in the normal period than in the immediate post-flood period. On the average, more than two-thirds of dependent workers were employed on a casual (temporary) basis. The place of work for two-thirds of dependent workers was outside their home district, while more than 30 percent worked within their own *thana;* this pattern stayed the same over 1997–98. This indicates that people who had a dependent job did not move during the time of the floods.

Summary

The floods of 1998 had a major direct impact on rural households because of the decrease in agricultural production and the losses of standing crops and other assets. Overall, agricultural production was reduced by 48 percent among survey households, with transplanted *aman* and deep water *aman* crop losses exceeding 80 percent. These large crop losses suggest the need to develop technologies that can shorten the time needed to produce other rice and nonrice crops, thereby increasing the production possibilities for the periods before and after the usual flood periods (Hossain, Bose, and Chowdhury 2001).

Damage to houses and losses of other valuable assets were strongly correlated with flood exposure. The values of the losses were significant for many households and especially for poorer households. Not only did the poor have fewer assets than richer households, but they suffered bigger losses in percentage terms as well.

Even though there was little open unemployment in the sample *thanas,* labor participation rates were very low. The few people in each household who relied on finding a job in the labor market for their livelihood worked fewer days and suffered losses of wage earnings during and immediately after the floods. Thus, the thinness and unreliability of the labor market increases the vulnerability of day laborers to large economic shocks such as the 1998 floods.

CHAPTER 5

Impact of the Floods on Food Consumption, Food Security, Health, and Nutrition

One of the most direct ways in which natural disasters such as floods affect people's lives is through deterioration in their physical well-being, the ultimate outcome of a myriad of flood-impact pathways as illustrated in Figure 2.2. The state of people's physical well-being in November 1998 reflected a combination of flood-related factors in addition to their pre-flood state. These include (1) the severity of their direct exposure to the floods; (2) the coping strategies they or their caregivers employed in response to it; and (3) the relief from the government and nongovernmental organizations (NGOs) that they took advantage of. In this chapter we examine the impact of the floods on people's physical well-being, the impact being considered to be the combined result of all of these factors.

The chapter first examines the effects of the floods on food consumption during the period shortly after the water receded and the ability of households to maintain secure access to sufficient food for their members on a sustainable basis, that is, household food security. It then takes a look at whether the floods led to any increase in gender inequality in intra-household food distribution. After examining the effects of the floods on the quality of people's health environment and on illness, we turn to consideration of their effect on the nutritional status of preschool children and women.

Household Food Consumption

Even in normal circumstances an exceptionally large percentage of households in Bangladesh do not consume enough food to meet their members' dietary energy requirements, close to 50 percent—55 million people—according to the latest national food expenditures survey (BBS 1998). Additionally, consumption of nutrient-rich animal products is far lower than recommended levels. Micronutrient deficiencies, for example deficiencies of iron, iodine, and vitamin A, are widespread owing to low-quality diets consisting primarily of the main food staples, rice and wheat (Bouis and Novenario-Reese 1997; UNICEF-ADB 1997; NPAN 1997; and Ahmed et al. 1998).

During and after the floods there was no national food supply crisis (see Chapter 3). Chapter 4 showed, however, that people experienced reduced incomes owing to losses of agricultural

production, lack of employment, and losses of assets. As a result, field surveys undertaken during the floods reveal that households experienced increased difficulty in accessing food. They reported less-than-normal food consumption, reduced number of meals, and/or a reduction in the variety of foods eaten, with many households eating meals consisting only of rice (Khan and Haque 1998; World Food Programme (WFP) 1998; Hossain and Shuaib 1998; Democracy Watch 1998).

In addition to the reduced access to resources, people faced increases in the price of rice and other commodities. The rise in the price of vegetables, because of the destruction of many people's home gardens and the lack of production as a result of water standing in the fields, was particularly harmful, since vegetables represent the most important source of micronutrients in the diet.

Another factor contributing to reduced food consumption was a severe shortage of fuel for cooking. Existing sources of fuel were damp, difficult to obtain, or being used as emergency fodder. Additionally, it was difficult to light fires. Thus, even households that did have access to sufficient food had difficulty preparing it.[52]

By the time the floods had ended, most households were maintaining a stable level of total expenditures using a combination of coping strategies (see Chapters 4 and 6). Here we use the household survey data to examine whether, in the floods' immediate aftermath, households nevertheless continued to experience reduced food consumption. We also look at whether the floods led to any change in the types of foods eaten. To do so we use data collected on the consumption of 256 different foods in the month before the survey.

Tables 5.1 and 5.2 list the types of foods consumed and compare their importance in the diet of sample households. Rice is by far the most important food. Almost all households consumed some rice on a daily basis; it accounted for the majority of calories consumed (67 percent; Table 5.1) and the largest budget share (44 percent; Table 5.2). The other major staple in the diet, wheat, was consumed by about 58 percent of households but played a much less important role in terms of calories and the food budget. Vegetables and fish are almost universally consumed and have the next highest budget shares after rice (Table 5.2). Additional important food items from a nutritional standpoint are meat, eggs, and milk. These foods have a high protein and micronutrient content, but are not widely consumed.

Whereas total food expenditures changed very little across the flood exposure groups, Table 5.1 shows that the quantities consumed of individual foods did. Rice consumption appears to decline significantly with increased severity of flood exposure: households in the very severely exposed group consumed 20 percent less rice than those not exposed. Consumption of wheat, which was distributed as food aid in the post-flood period (see Chapter 7) and was relatively cheaper than rice, registered a substantial increase. However, the total quantity of rice and wheat consumed declined across the groups. There was no substantial difference in rice and wheat prices across groups (Table 5.2),[53] but the total budget share for these two commodities declined from 52 percent in the non-exposed group to 47 percent in the very severely exposed group.

Consistent with field reports, a steep decline can be found in the consumption of vegetables—a reduction of 42 percent between the very severely exposed and non-exposed households. This trend was matched by a steep increase in the price of vegetables (Table 5.2). Although not as strong, the same trends can be found for fruits. Other foods with price increases across the groups are

[52] Sources: HKI 1998a, Khan and Haque 1998, WFP 1998, del Ninno and Roy 1999a, BHC 1998, Hena and Kabir 1998, Rahman and Choudhury 1998.

[53] This is consistent with the finding that rice prices increased after the *boro* harvest and remained high and that they did not vary very much across regions.

Table 5.1 Households consuming 15 foods and daily per capita quantities consumed, by severity of flood exposure

	Flood exposure										
	Not exposed		Moderate		Severe		Very severe		All households		
Type of food	Percent consuming	Quantity (grams)	Percent consuming	Quantity (grams)	Percent consuming	Quantity (grams)	Percent consuming	Quantity (grams)	Percent consuming	Quantity (grams)	Calorie share (%)
Rice	99.5	498.7	98.8	436.1	99.5	386.6	98.8	402.4	99.2	433.0	66.65
Wheat	45.6	42.2	59.4	51.7	67.6	59.6	60.7	60.4	58.0	53.1	8.52
Bread and other cereals	15.7	2.2	14.6	1.7	17.4	1.8	19.6	1.9	16.8	1.9	0.30
Pulses	80.7	14.6	77.0	19.5	82.6	20.2	86.9	18.2	81.8	18.0	3.00
Oil	98.6	8.3	97.0	8.9	98.6	7.7	98.8	8.4	98.3	8.3	3.49
Vegetables	99.5	236.7	100.0	204.8	100.0	171.7	99.4	166.5	99.7	196.4	5.08
Meat	51.6	9.5	50.9	10.9	55.6	10.1	51.8	9.9	52.6	10.0	0.52
Eggs	63.1	4.1	57.6	4.7	54.1	3.0	57.7	3.8	58.3	3.9	0.29
Milk	55.8	22.2	38.8	17.3	36.7	11.3	39.3	13.9	43.2	16.3	0.44
Fruits	71.0	32.1	66.7	27.4	68.6	25.0	74.4	29.6	70.2	28.6	0.88
Fish	97.2	39.6	98.2	45.5	98.6	42.1	98.8	47.6	98.2	43.3	2.30
Spices	99.5	24.7	100.0	27.1	99.5	25.6	99.4	24.8	99.6	25.5	1.72
Sugar and snacks	88.0	25.1	85.5	27.6	86.0	24.3	88.1	24.1	86.9	25.2	4.15
Drinks and others	65.9	5.7	69.7	12.9	75.9	11.8	78.6	9.2	72.3	9.7	0.42
Prepared foods	19.8	6.2	24.2	24.0	30.0	18.6	32.7	19.0	26.4	16.3	2.24
Per capita daily calories	2,411.0		2,295.0		2,063.0		2,157.0		2,234.0		
Per capita daily protein	75.9		76.1		70.2		72.6		73.7		
Number of households	217		164		206		168		755		

Source: IFPRI-FMRSP, Household Survey 1998.

fish, meat, eggs, and prepared foods. Nevertheless, no decline in the consumption of these foods across the groups is apparent. Consequently, their budget shares increased (with the exception of eggs). This trend is particularly noticeable for prepared foods, on which flood-exposed households were probably more dependent given the destruction of their homes and continued difficulties in meal preparation. Even though the price of milk declined, there was a large fall in its consumption and budget share with increased severity of flood exposure. One of the few commodities to experience an increase in the budget share was fish, probably from an increase in catches from open water.

As a result of the trends in consumption patterns presented above, the reduction in the most calorie-dense foods in the diet likely explains a large part of the reduction in flood-exposed households' calorie consumption, shown at the bottom of Table 5.1. Average mean daily calorie consumption was 2,234 kilocalories per person, just below the minimum energy requirement of 2,273.[54] The flood-exposed households as a group

[54] These numbers can be compared with those reported for rural households in the 1995/96 national food expenditures survey: 2,263 calories (BBS 1998).

Table 5.2 Food budget shares and price indexes of 15 foods, by severity of flood exposure

	Flood exposure									
	Not exposed		Moderate		Severe		Very severe		All households	
Type of food	Budget share (%)	Price index	Budget share (%)	Price index	Budget share (%)	Price index	Budget share (%)	Price index	Budget share (%)	Price index
Rice	48.61	0.97	43.08	0.99	41.14	0.99	41.95	1.00	43.88	0.99
Wheat	3.39	0.97	4.4	0.99	5.6	1.00	5.49	1.03	4.68	1.00
Bread and other cereals	0.28	0.97	0.27	1.05	0.32	1.12	0.26	0.88	0.28	1.00
Pulses	2.20	0.99	3.13	1.01	3.44	0.98	3.44	1.00	3.02	0.99
Oil	2.85	1.01	3.27	1.01	2.92	0.97	3.17	0.99	3.03	1.00
Vegetables	13.37	0.95	12.59	1.06	12.49	1.09	11.85	1.10	12.62	1.05
Meat	3.23	0.96	3.56	0.98	3.79	1.02	3.60	1.05	3.54	1.00
Eggs	1.34	0.98	1.34	0.98	1.13	1.01	1.21	1.03	1.25	1.00
Milk	2.07	1.08	1.44	1.01	1.05	0.96	1.03	0.89	1.42	1.00
Fruits	2.44	0.92	2.55	0.96	2.69	1.07	2.87	1.04	2.63	1.00
Fish	8.02	1.02	8.60	1.03	9.03	1.11	9.58	1.06	8.77	1.06
Spices	4.94	1.00	5.88	1.01	5.96	1.02	4.95	1.02	5.43	1.01
Sugar and snacks	3.72	0.99	4.23	0.99	4.41	1.05	4.52	1.05	4.20	1.02
Drinks and others	2.59	0.91	3.87	0.89	4.55	1.08	3.88	1.13	3.69	1.01
Prepared foods	0.95	1.09	1.80	0.91	1.47	0.95	2.2	1.11	1.55	1.02
Food budget share	72.1		69.9		69.2		71.1		70.6	
Total per capita expenditures per month	761.0		793.0		715.0		740.0		751.0	
Number of households	217		164		206		168		755	

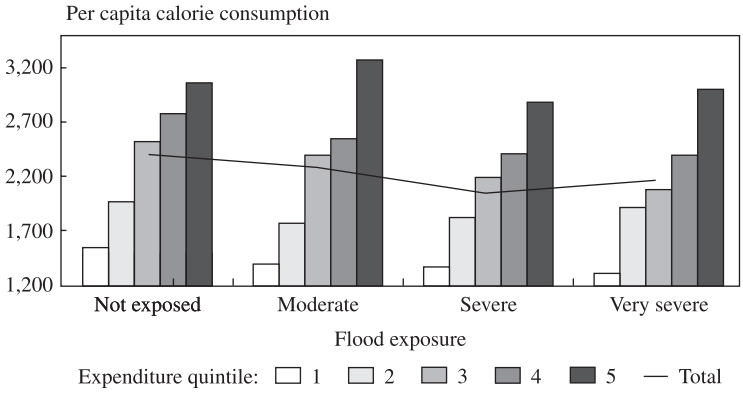
Source: IFPRI-FMRSP, Household Survey 1998.

consumed 248 calories per person less than those not exposed. This may seem a small difference, but it means that members of flood-exposed households were much more likely to consume fewer calories than are needed for a healthy and active life. The percentage of non-exposed households falling below the minimum requirement was 45.6 percent; for exposed households it rose to 60 percent.

Figure 5.1 shows that per capita calorie consumption is strongly related to current per capita total expenditures, our proxy measure for income. Within each flood exposure group, per capita calorie consumption rises steeply with total expenditures. The figure also gives an indication that richer households as a group experienced fewer negative effects on their food consumption as a result of the floods. The difference between non-exposed and exposed households' per capita calorie consumption in the highest expenditure quintile is less than 1 percent. That is, being exposed to the floods is associated with basically no change in rich households' calorie consumption. In contrast, the difference between non-exposed and exposed for the poorest quintile is 11 percent.

Table 5.3 reports regression results examining the overall effect of the floods on household per capita calorie consumption. As in previous models, flood exposure is captured using dummy variables representing moderate, severe, and very severe flood exposure. In addition to the independent variables used in the previous chapter, we include the food price index since we expect food prices to affect calorie consumption independently of the floods. However, because the floods themselves are associated with an

Figure 5.1 Household daily per capita calorie consumption, by expenditure quintile and severity of flood exposure



Source: IFPRI-FMRSP, Household Survey 1998.

increase in food prices, the full impact of the floods might be mediated by the price changes.[55]

The regressions confirm that the floods led to a reduction in food consumption for many households. A household located in a village that was moderately exposed to the floods likely experienced no decline in its calorie intakes. However, a household located in a severely exposed village experienced a decline of more than 216 kilocalories, as indicated by the regression. The coefficient on the very severe exposure dummy variable is negative, smaller, and not statistically significant. Though households in very severely exposed villages probably experienced some reduction in their food consumption, the reductions were likely smaller than for those in severely exposed villages, possibly because of the greater food aid allocated to the former (see Chapter 7).

The model with household-level flood exposure and village fixed effects (presented in the last two columns of Table 5.3) shows that, after taking into account village-level characteristics, including flood exposure, the difference between the way individual households in the same village were exposed to the floods did not have any impact on their level of caloric consumption. On the other hand, we found that households exposed to the floods and living in a more severely flood-exposed village were worse off than non-flood-exposed households living in the same village in terms of caloric consumption.[56]

Household Food Security

The reduced level of caloric consumption and the additional expenses that households incurred in order to maintain the same level of consumption had an impact on the level of households' food security. In this section we propose a measure of household food security and try to analyze the strength of the link between level of household food security and exposure to the floods.

Several indicators of household food security have been proposed in the literature (Haddad et al. 1994; Maxwell et al. 1999). Most of them revolve around measures of food consumption (Bouis 1993), though some studies expand the concept of food security to include other dimensions of poverty besides income poverty and to include values of assets, the risks of facing shocks, and the adoption of coping strategies (Frankenberger 1992; Maxwell and Frankenberger 1992).

The indicators used in the analysis in this report have been calculated following the conceptual framework presented by Johnson and Toole (1991) and used by the Accra Study Team (1998), which looks at food availability and the constraints faced by households in acquiring food. In practice, we defined food security using the combination of adequacy of caloric availability and proportion of total current expenditure allocated to food. Households that do not consume adequate amounts of calories and that allocate a large share of their budget to food are

[55] In any case we found that the results of the model without the price variable—to capture the full effect of the floods—did not change very much.

[56] The coefficients of the flood exposure dummy variable in a fixed effects model for a sample of 108 households living in severely flood-exposed villages were large and significant.

Table 5.3 Determinants of household daily per capita calorie consumption: Regression results

	Village-level flood exposure		Household-level flood exposure with village fixed effects	
	Coefficient	***t*-statistic**	**Coefficient**	***t*-statistic**
Female-headed household	–599.36	–3.42*	–706.81	–4.15*
Age of household head	–3.77	–0.73	–0.24	–0.06
Percent males 0–4	–7.00	–0.51	–5.39	–1.18
Percent males 5–14	–3.94	–0.59	–5.14	–1.19
Percent males 15–19	–4.68	–0.72	–6.06	–1.18
Percent males 20–34	0.05	0.01	0.03	0.01
Percent males 35–54	–2.57	–0.55	–3.01	–0.72
Percent females 0–4	–13.25	–3.03*	–13.02	–3.02*
Percent females 5–14	–10.60	–2.55*	–10.82	–2.74*
Percent females 15–19	–3.95	–0.78	–5.88	–1.17
Percent females 20–34	–4.73	–0.85	–5.29	–1.29
Percent females 35–54	5.07	1.34	2.41	0.62
Household size	–110.86	–0.95	–98.83	–1.97*
Number of males: Any primary education	36.40	0.80	8.44	0.20
Number of males: Any secondary education	52.07	0.93	55.51	0.89
Number of females: No education	26.57	0.16	–21.93	–0.25
Number of females: Any primary education	49.42	0.29	41.14	0.44
Number of females: Any secondary education	76.47	0.44	134.50	1.22
Pre-flood value of land (Tk thousand)	–0.53	–0.30	–0.39	–0.25
Productive asset value (Tk thousand)	78.28	1.88*	89.98	2.69*
Liquid asset value (Tk thousand)	–4.43	–0.58	–2.40	–0.26
Housing asset value (Tk thousand)	39.01	4.03*	31.89	3.03*
Domestic asset value (Tk thousand)	178.01	1.24	171.25	1.47
Other assets value (Tk thousand)	282.09	1.58	367.69	1.28
Food price index	–328.77	–0.70	19.91	0.04
Moderately flood exposed	–10.80	–0.08	3.77	0.03
Severely flood exposed	–181.80	–1.56	–4.17	–0.03
Very severely flood exposed	–93.14	–0.65	–49.26	–0.37
Constant	3,518.67	7.03*	3,048.38	5.13*
R^2	.19		.17	
Number of observations	753		751	
Number of villages	117		117	

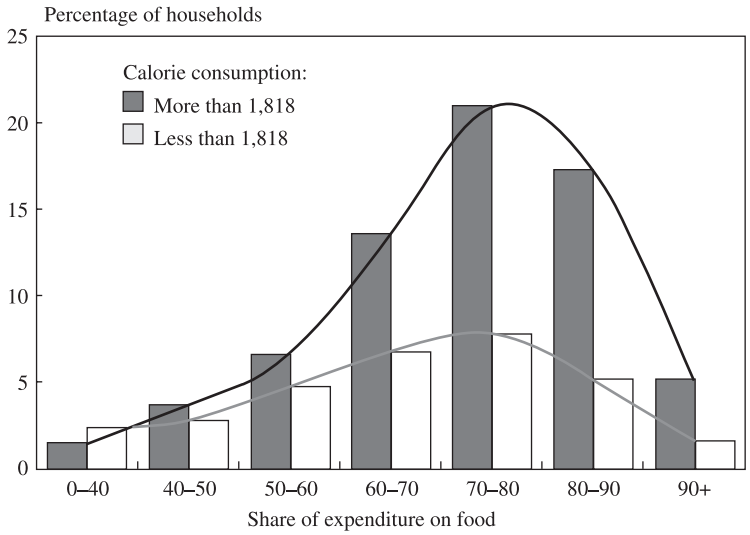
Source: IFPRI-FMRSP, Household Survey 1998 and authors' calculations.

Notes: The food price is represented by an index running from 0.74 to 1.55.
* denotes that the coefficient is statistically significant at the 10% level or less.

defined as food insecure. Similarly, households that consume adequate amounts of calories and that allocate a smaller portion of their budget to food are clearly food secure. Households that allocate a high proportion of their budget to food and that consume adequate amounts of calories are defined as "vulnerable" because, if the level of total expenditure is reduced, their level of caloric consumption will fall as well, since they have little scope for increasing expenditure to meet their caloric requirements. Finally, households that do not consume adequate amounts of calories and do not allocate a large portion of their budget to food are defined as "questionable" in regard to food security status. This is because they could increase the level of expenditure on food to meet their caloric requirements, but they have other constraints that prevent them from doing so or they simply choose not to do so.

The resulting classification of households into the food security categories outlined above is presented in Figure 5.2 and

Figure 5.2 Distribution of households with consumption above and below the minimum caloric requirement, by share of expenditure on food



Source: IFPRI-FMRSP, Household Survey 1998.

Tables 5.4 and 5.5. We used a cutoff of 1,818 calories, equal to 80 percent of the recommended daily intake in Bangladesh (BBS 1998), and a cutoff of expenditure allocated to food equal to 70 percent of the budget (similar to the mean for all households).

Figure 5.2 shows the distribution of households above and below the minimum caloric requirement by their share of expenditure on food. Looking at the distribution of households that meet their minimum caloric requirement, we see that, by allocating an increasing share of their budget to food, households are able to maintain an adequate level of caloric consumption and are therefore moving from a situation of food security to vulnerability. It is also interesting to note that over 20 percent of the households allocate between 70 and 80 percent of their budget to food, just past the cutoff of 70 percent.

The distribution of households that do not meet their minimum caloric requirement (Figure 5.2) contains fewer households and therefore lies under the distribution of households that meet their minimum caloric requirement. Moving from right to left in this case, we go from households that are food insecure towards households that have a questionable food security status.

It is evident from this graph that a small adjustment in the cutoff for the budget share indicator would have a relatively large effect on the number of households classified as food insecure.

Table 5.4 shows that, although the share of food expenditure did not change very much across categories of flood exposure, the average daily consumption of calories decreased from 2,411 for households not exposed to the floods to 2,097 and 2,158 for households severely and very severely ex-

Table 5.4 Food security by severity of flood exposure

		Flood exposure			
	Not exposed	Moderate	Severe	Very severe	Total
Food share of expenditure	72.1	69.9	69.2	71.1	70.6
Per capita monthly expenditure	760.9	793.2	715.5	739.8	750.9
Per capita daily calories	2,410.7	2,320.3	2,096.7	2,157.2	2,248.9
Percent of households spending > 70% on food	60.4	60.0	54.6	57.1	58.0
Percent of households consuming < 1,818 calories per capita daily	19.4	32.7	38.7	35.7	31.2
Food insecure	12.0	15.2	15.5	16.1	14.5
Vulnerable	48.4	44.9	39.1	41.1	43.5
Food secure	32.3	22.4	22.2	23.2	25.4
Questionable	7.4	17.6	23.2	19.6	16.6
Number of households	217	165	207	168	757

Source: IFPRI-FMRSP, Household Survey 1998.

posed to the floods, respectively. As a result, only 12.0 percent of the households not exposed to the floods are food insecure, compared with 16.1 percent of those exposed severely to the floods, while the percentage of food secure households decreased from 32.3 percent for non-exposed households to around 22 percent for households exposed to the floods.

The difference in the level of food security for flood-exposed households across expenditure quintiles is, as expected, quite large (Table 5.5). Only 2 percent of the households in the first quintile are food secure whereas practically no households in the top two quintiles are food insecure.

To assess the impact of the floods on different levels of food security we ran two sets of models. In the first, we tried to explain the level of each of the outcomes of the food security indicators described above using logit models, first using a village-level flood exposure variable and then using a household-level flood exposure variable with village random and fixed effects. In the second, we modeled the alternative outcomes of food security status using a multinomial logit model in which we look at the probability of food secure households becoming food insecure, vulnerable, or questionable.

The results of the first set of models (Tables 5.6(a), (b), and (c)) show that the probability that food security status of households changes to questionable when exposed to the floods increases in all the models. Households exposed to the floods also have a higher probability of being food insecure, even though the coefficient of the model with the village-level flood exposure variable is significant only with 80 percent probability. Moreover, in the fixed effects model the probability that the food security status of households changes to being secure decreases, and the probability that it changes to vulnerable increases, if they have been exposed to the floods. This means that the differential flood exposure of households from the same village had a large impact on the level of food security.

The results of the multinomial logit model (Table 5.7) confirm the results obtained above. The probability that the food security status of food secure households changes to questionable or insecure is positive, even though the coefficient of flood exposure for the food insecurity outcome is not very significant.

Table 5.5 Food security by expenditure quintile for flood-exposed households

	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	Total
Food share of expenditure	73.2	72.5	71.6	68.5	63.9	70.0
Per capita monthly expenditure	343.1	505.8	648.9	842.6	1434.3	746.8
Per capita daily calories	1,367.6	1,836.5	2,194.8	2,460.8	3,140.4	2,183.8
Percent of households spending > 70% on food	66.4	59.3	66.0	50.5	0.4	0.6
Percent of households consuming < 1,818 calories per capita daily	79.7	50.4	24.5	12.9	0.1	0.4
Food insecure	47.8	16.8	9.4	0.0	0.9	15.6
Vulnerable	18.6	42.5	56.6	50.5	41.1	41.5
Food secure	1.8	7.1	18.9	36.6	51.4	22.6
Questionable	31.9	33.6	15.1	12.9	6.5	20.4
Number of households	113	113	106	101	107	540

Source: IFPRI-FMRSP, Household Survey 1998.

Table 5.6a Determinants of food security status: Village flood exposure logit model

	Food insecure		Vulnerable		Food secure		Questionable	
Variable	Odds ratio	*z*-statistic	Odds ratio	*z*-statistic	Odds ratio	*z*-statistic	Odds ratio	*z*-statistic
Female headed household	2.28	1.54	0.75	–0.67	0.37	–1.63	1.85	1.03
Age of household head	1.01	0.79	1.00	–0.01	0.99	–0.89	1.01	0.43
Percent males 0–4	1.03	1.81*	0.98	–1.75*	0.99	–0.71	1.02	1.39
Percent males 5–14	1.00	0.29	1.00	–0.46	0.99	–0.52	1.01	0.82
Percent males 15–19	1.01	0.43	0.98	–1.90*	1.02	1.09	1.02	0.79
Percent males 20–34	0.98	–1.01	0.99	–1.28	1.02	1.70*	1.01	0.31
Percent males 35–54	0.99	–0.78	0.99	–1.03	1.01	1.09	1.01	0.69
Percent females 0–4	1.01	0.63	0.97	–2.29*	1.00	0.00	1.04	2.51*
Percent females 5–14	1.02	1.71*	0.99	–1.04	0.99	–1.08	1.01	0.84
Percent females 15–19	1.02	0.79	1.01	0.73	0.99	–0.78	0.98	–0.86
Percent females 20–34	1.01	0.77	0.99	–0.77	1.01	0.48	1.00	–0.03
Percent females 35–54	1.00	0.01	0.99	–0.72	1.01	1.22	0.99	–0.55
Household size	1.15	0.78	1.08	0.63	0.79	–1.55	1.04	0.26
Number of males: Any primary education	0.80	–1.46	0.99	–0.15	1.12	0.89	1.14	1.00
Number of males: Any secondary education	0.91	–0.38	0.69	–2.27*	1.60	2.82*	1.01	0.04
Number of females: No education	1.15	0.44	0.82	–0.85	1.11	0.41	1.00	–0.01
Number of females: Any primary education	0.79	–0.71	0.93	–0.33	1.31	0.97	1.09	0.27
Number of females: Any secondary education	0.95	–0.11	0.71	–1.16	1.35	0.96	1.38	0.81
Pre-flood value of land (Tk thousand)	0.99	–1.41	1.00	–0.24	1.00	0.37	1.00	1.54
Productive asset value (Tk thousand)	0.84	–1.03	1.02	0.19	1.09	0.91	0.99	–0.11
Liquid asset value (Tk thousand)	1.06	1.98*	0.96	–0.90	1.00	0.19	0.88	–1.22
Housing asset value (Tk thousand)	0.98	–0.41	1.04	1.37	1.03	0.91	0.90	–2.33*
Domestic asset value (Tk thousand)	0.74	–0.59	0.98	–0.09	1.34	1.01	0.77	–0.63
Other assets value (Tk thousand)	0.31	–0.57	0.17	–1.47	9.94	1.91*	0.33	–0.71
Flood exposure (dummy)	1.75	1.86*	0.55	–3.29*	0.98	–0.07	2.12	2.65*
Number of observations		753		753		753		753
χ^2		77.01		56.03		93.38		40.02
Prob χ^2		0.00		0.00		0.00		0.00
Pseudo R^2		.12		.05		.11		.07

Source: IFPRI-FMRSP, Household Survey 1998 and authors' calculations.

* denotes that the coefficient is statistically significant at the 10% level or less.

Gender Discrimination in Intrahousehold Food Distribution

Discrimination against Bangladeshi females in the consumption of animal products has been well documented. These foods are the most preferred in the Bangladeshi diet, which explains why they are the locus of the most pronounced discrimination; they also have high concentrations of protein and bioavailable micronutrients, nutrients in which Bangladeshi women are particularly deficient (Bouis and Novenario-Reese 1997; Bouis et al. 1998a; Ahmed et al. 1998).[57] Further, although there is no evidence of intentional anti-female discrimination in the distribution of high-calorie staple foods, females of all ages are more calorie deficient than males (Bouis and Novenario-Reese 1997), and the prevalence of chronic energy deficiency among women is the highest in the world.

[57] See Harriss (1995) for a review of past studies on gender discrimination in intrahousehold food distribution in South Asia. The studies' conclusions have varied widely, and many have relied on measures of discrimination that are not considered valid owing to the difficulties of interpersonal comparisons raised later in this section.

Table 5.6b Determinants of food security status: Household-level flood exposure logit model with village random effects

	Food insecure		Vulnerable		Food secure		Questionable	
Variable	Odds ratio	*z*-statistic	Odds ratio	*z*-statistic	Odds ratio	*z*-statistic	Odds ratio	*z*-statistic
Female-headed household	2.19	1.37	0.75	–0.64	0.37	–1.64	1.90	1.05
Age of household head	1.01	0.54	1.00	0.17	0.99	–0.95	1.01	0.42
Percent males 0–4	1.03	1.79*	0.98	–1.65*	0.99	–0.87	1.02	1.48
Percent males 5–4	1.01	0.32	1.00	–0.27	0.99	–0.63	1.01	0.73
Percent males 15–19	1.01	0.42	0.97	–1.96*	1.02	1.03	1.02	0.85
Percent males 20–34	0.98	–1.08	0.99	–1.14	1.02	1.57	1.00	0.28
Percent males 35–54	0.98	–0.88	0.99	–0.90	1.01	1.16	1.01	0.49
Percent females 0–4	1.01	0.58	0.97	–2.22*	1.00	0.01	1.04	2.58*
Percent females 5–14	1.02	1.63	0.99	–1.01	0.99	–1.17	1.01	0.92
Percent females 15–19	1.01	0.75	1.01	0.78	0.99	–0.83	0.98	–0.76
Percent females 20–34	1.01	0.79	0.99	–0.91	1.00	0.37	1.00	0.23
Percent females 35–54	1.00	0.15	0.99	–0.75	1.01	1.01	0.99	–0.36
Household size	1.16	0.78	1.07	0.51	0.81	–1.41	1.07	0.38
Number of males: Any primary education	0.78	–1.51	0.98	–0.20	1.11	0.84	1.16	1.07
Number of males: Any secondary education	0.90	–0.38	0.69	–2.22*	1.62	2.89*	0.99	–0.05
Number of females: No education	1.22	0.58	0.83	–0.82	1.10	0.36	0.97	–0.11
Number of females: Any primary education	0.81	–0.61	0.92	–0.34	1.30	0.95	1.07	0.21
Number of females: Any secondary education	0.90	–0.22	0.75	–0.97	1.36	0.97	1.28	0.62
Pre-flood value of land (Tk thousand)	0.99	–1.38	1.00	–0.34	1.00	0.38	1.00	1.75*
Productive asset value (Tk thousand)	0.80	–1.19	1.01	0.15	1.09	0.92	0.98	–0.19
Liquid asset value (Tk thousand)	1.07	2.04*	0.96	–0.98	1.01	0.26	0.86	–1.32
Housing asset value (Tk thousand)	0.99	–0.16	1.03	1.10	1.03	0.99	0.89	–2.32*
Domestic asset value (Tk thousand)	0.58	–0.99	1.11	0.36	1.17	0.55	0.76	–0.62
Other assets value (Tk thousand)	0.28	–0.62	0.15	–1.49	9.23	1.83*	0.34	–0.67
Flood exposure (dummy)	1.12	0.37	0.82	–1.06	0.64	–2.22*	3.17	3.78*
Number of observations		753		753		753		753
Number of villages		117		117		117		117
χ^2		52.58		39.85		79.92		43.13
Prob χ^2		0.00		0.03		0.00		0.01

Source: IFPRI-FMRSP, Household Survey 1998 and authors' calculations.

* denotes that the coefficient is statistically significant at the 10% level or less.

Given the already precarious nutritional state of large numbers of girls and women in Bangladesh—and the close association between the health and nutrition of children and their mothers (see below)—any further increase in discrimination against females in food consumption would have serious consequences for current and future generations. We investigate whether the floods led to such an increase by asking two questions. First, did females experience greater reductions in staple food consumption than males? Second, did the floods exacerbate existing discrimination against females in the consumption of animal products?

To answer these questions, data on individuals' consumption of meals containing six key foods—rice, wheat, fish, meat, milk, and eggs—were collected as part of the household survey. As seen above, rice and wheat are by far the main sources of dietary energy. The rest of the foods are the animal products on which discrimination centers. Together, the six foods made up more than 75 percent of total calorie consumption (see Table 5.1). The data were collected using a 24-hour recall food weighing method.[58] Note that the

[58] The information on individual food consumption was collected from the person (a woman) who was responsible for food preparation. She was first asked to list the dishes prepared for each meal of the previous day and the amounts of the six key foods used. She was then asked which household members ate the dishes containing the foods. Finally, the

Table 5.6c Determinants of food security status: Household-level flood exposure logit model with village fixed effects

	Food insecure		Vulnerable		Food secure		Questionable	
Variable	Odds ratio	*z*-statistic	Odds ratio	*z*-statistic	Odds ratio	*z*-statistic	Odds ratio	*z*-statistic
Female-headed household	2.11	1.08	0.53	–1.28	0.52	–0.98	2.10	1.05
Age of household head	1.00	–0.15	1.01	0.97	1.00	0.07	0.99	–0.48
Percent males 0–4	1.04	1.63	0.98	–1.68*	0.99	–0.71	1.02	1.21
Percent males 5–14	1.01	0.51	1.00	–0.03	0.99	–0.88	1.00	0.22
Percent males 15–19	1.00	0.09	0.97	–2.30*	1.02	1.17	1.02	1.02
Percent males 20–34	0.98	–0.84	0.99	–1.01	1.03	1.69*	*0.99	–0.30
Percent males 35–54	0.98	–0.92	0.99	–0.89	1.02	1.61	1.00	–0.23
Percent females 0–4	1.00	0.04	0.98	–1.89*	1.00	0.18	1.03	1.96*
Percent females 5–14	1.02	1.26	0.99	–1.25	0.99	–0.79	1.01	0.67
Percent females 15–19	1.01	0.61	1.01	0.53	1.00	–0.30	0.99	–0.67
Percent females 20–34	1.01	0.71	0.98	–1.55	1.01	0.94	1.01	0.50
Percent females 35–54	1.02	0.83	0.99	–1.28	1.01	0.67	1.00	–0.08
Household size	1.05	0.20	1.16	1.07	0.75	–1.49	1.08	0.39
Number of males: Any primary education	0.74	–1.48	0.92	–0.74	1.20	1.26	1.18	1.07
Number of males: Any secondary education	0.90	–0.35	0.68	–2.12*	1.88	3.10*	0.96	–0.17
Number of females: No education	1.57	1.16	0.77	–1.04	1.07	0.20	0.97	–0.08
Number of females: Any primary education	0.92	–0.22	0.90	–0.40	1.26	0.69	0.99	–0.02
Number of females: Any secondary education	0.84	–0.35	0.84	–0.55	1.48	1.04	1.25	0.53
Pre-flood value of land (Tk thousand)	0.98	–1.49	1.00	–0.09	1.00	0.03	1.01	1.74*
Productive asset value (Tk thousand)	0.75	–1.31	1.01	0.10	1.20	1.44	0.97	–0.24
Liquid asset value (Tk thousand)	1.07	1.90*	0.93	–1.13	1.01	0.22	0.89	–0.95
Housing asset value (Tk thousand)	1.01	0.19	1.02	0.66	1.02	0.49	0.89	–1.98*
Domestic asset value (Tk thousand)	0.72	–0.50	0.82	–0.61	1.38	0.89	0.78	–0.45
Other assets value (Tk thousand)	0.11	–0.80	0.18	–1.34	4.11	1.35	0.14	–1.03
Flood exposure (dummy)	0.46	–1.43	1.69	1.72*	0.53	–1.96*	2.17	1.71*
Number of observations		444		717		657		485
Number of villages		69		111		101		75
χ^2		73.56		53.18		101.37		36.39
Prob χ^2		0.00		0.00		0.00		0.07

Source: IFPRI-FMRSP, Household Survey 1998 and authors' calculations.

* denotes that the coefficient is statistically significant at the 10% level or less.

data used here are the quantities, measured in grams, that people consumed of "dishes" containing the six foods rather than of the foods themselves. For rice and wheat, the dishes generally contained only that one food. For the other foods, one dish (for example, fish curry) may have contained other ingredients as well (for example, vegetables or oil).[59] The sample consisted of 1,613 females and 1,647 males over the age of three years.

Turning first to the main staples, Figure 5.3(a) shows how female and male consumption of rice and wheat combined varies across the flood exposure severity groups. Both male and female consumption declined across the groups. Male consumption fell precipitously with moderate and severe exposure. Female consumption declined from the non-exposed to the moderately exposed group and then remained flat. Table

amount eaten of the dishes by each member was determined using direct food weighing or standardized tables of portion weights by portion size. If any member was not present at a meal, that person was interviewed to determine the quantities eaten of the six foods. If the person was not available for interview, then the primary respondent was asked to estimate the amount they had eaten.

[59] Because our measures of differences between people in food consumption do not rely on direct comparisons of quantities or nutrients consumed, this factor does not affect the results of the analysis.

Table 5.7 Determinants of food security status: Village-level flood exposure multinomial logit model

	Questionable		Vulnerable		Food insecure	
Variable	**Odds ratio**	***z*-statistic**	**Odds ratio**	***z*-statistic**	**Odds ratio**	***z*-statistic**
Female-headed household	4.21	1.80*	1.95	1.03	4.59	2.02*
Age of household head	1.01	0.89	1.01	0.66	1.02	1.12
Percent males 0–4	1.03	1.50	1.00	–0.20	1.03	1.71*
Percent males 5–14	1.02	0.92	1.00	0.22	1.01	0.50
Percent males 15–19	1.00	0.15	0.98	–1.51	1.00	–0.15
Percent males 20–34	0.99	–0.52	0.98	–1.65*	0.97	–1.61
Percent males 35–54	1.00	0.05	0.99	–1.13	0.98	–1.13
Percent females 0–4	1.03	1.83*	0.99	–1.11	1.01	0.57
Percent females 5–14	1.02	1.29	1.00	0.37	1.03	1.84*
Percent females 15–19	0.99	–0.24	1.01	0.86	1.02	1.01
Percent females 20–34	1.00	–0.24	0.99	–0.64	1.01	0.36
Percent females 35–54	0.98	–0.99	0.99	–1.14	0.99	–0.64
Household size	1.24	1.05	1.25	1.36	1.36	1.40
Number of males: Any primary education	1.01	0.07	0.90	–0.82	0.75	–1.59
Number of males: Any secondary education	0.74	–1.26	0.59	–2.84*	0.66	–1.44
Number of females: No education	0.95	–0.15	0.85	–0.58	1.03	0.09
Number of females: Any primary education	0.87	–0.38	0.78	–0.82	0.66	–1.04
Number of females: Any secondary education	1.05	0.12	0.67	–1.18	0.77	–0.51
Pre-flood value of land (Tk thousand)	1.01	0.98	1.00	–0.33	0.99	–1.36
Productive asset value (Tk thousand)	0.93	–0.54	0.94	–0.64	0.79	–1.24
Liquid asset value (Tk thousand)	0.87	–1.21	0.97	–0.69	1.04	1.40
Housing asset value (Tk thousand)	0.89	–2.25*	1.00	0.17	0.96	–0.72
Domestic asset value (Tk thousand)	0.66	–0.90	0.83	–0.61	0.61	–0.87
Other assets value (Tk thousand)	0.14	–1.05	0.09	–1.72*	0.09	–0.98
Flood exposure (dummy)	2.00	2.14*	0.75	–1.28	1.69	1.52
Number of observations						753
LR χ^2						206.61
Prob > χ^2						0.00
Pseudo R^2						.11

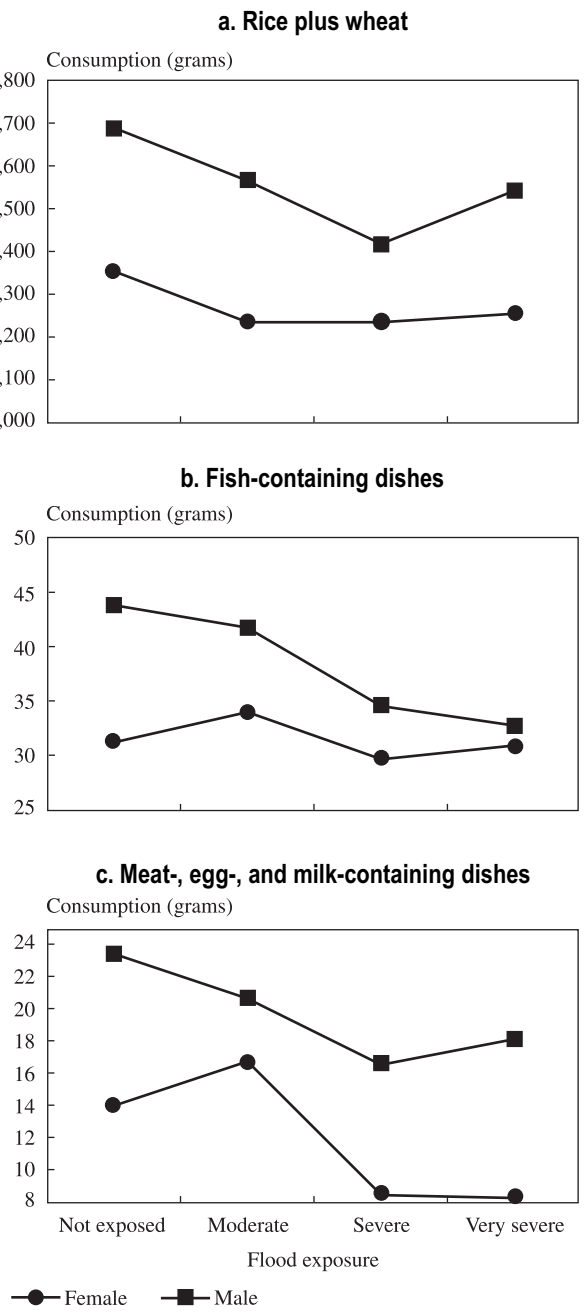
Source: IFPRI-FMRSP, Household Survey 1998 and authors' calculations.

Note: The base is food security.
* denotes that the coefficient is statistically significant at the 10% level or less.

5.8 reports regression results examining whether the floods had a differential impact on male and female consumption. The household-level measure of flood exposure with village fixed effects specification is employed. The results confirm that the floods led to declines in staple food consumption for both males and females in all exposure groups, with the greatest declines being associated with moderate exposure. Using the regression coefficients, we estimate that the staple consumption of the average male living in a flood-exposed household declined by 13.6 percent; that of the average female declined by 8.4 percent.[60] Thus, for the most important source of calories in the diet, female consumption likely did not decline by more than that of males. In fact, the opposite may have occurred. This indicates that, after a major disaster such as the floods, interventions targeted directly to flood-exposed households in Bangladesh can be very effective in increasing their consumption of staple foods.

[60] These percentages are calculated using a weighted average of the coefficients for the flood exposure severity dummy variable, where the weights are the proportion of flood-exposed individuals falling into each group.

Figure 5.3 Female and male consumption of meals containing six staple foods, by severity of flood exposure



Turning next to flood impacts on individuals' consumption of animal products, Figures 5.3(b) and 5.3(c) show how female and male consumption of meals containing fish and those containing meat, eggs, or milk changed across the flood exposure groups. The latter three foods are grouped together because of the small numbers of households in which they are consumed on a daily basis. As would be expected, male consumption was always higher than female consumption. Male consumption of fish-containing meals declined more steeply with flood exposure severity than female consumption. Consumption of the three non-fish animal products declined across the groups for both males and females, but the disparity between male and female consumption was wider for the very severe exposure group than for the not-exposed group.

Although these figures are revealing, deliberate discrimination in food consumption (or a change in its degree) is difficult to detect by directly comparing nutrient or food consumption across groups of people. Problems arise because people of different genders, sizes, and activity patterns have different consumption requirements, which are not known for certain (Bouis and Novenario-Reese 1997). Further, a person or group of people could eat less food than needed simply because they and other household members are not aware of their requirements.

To determine whether the floods led to an increase in discrimination against females in animal product consumption, we used two measures. The first indicates simply whether or not a person consumed a particular food. The average of the measure for a group then gives the group's consumption incidence of that food. If the female consumption incidence fell by more than the male incidence as a consequence of the floods, this is telling evidence that discrimination in the consumption of that food has increased. A second measure, based on the approach of Bouis et al. (1998b), compares the *proportions* consumed of different foods across individuals in their own household. The Individual Relative Consumption Share (IRCS) is a ratio of the proportion an individual consumes of a food

Table 5.8 Determinants of female and male consumption of main staples: Regression results (household-level flood exposure with village fixed effects)

	Female		Male	
	Coefficient	***t*-statistic**	**Coefficient**	***t*-statistic**
Female-headed household	68.90	0.73	110.91	0.79
Age of household head	–2.19	–1.30	–1.09	–0.55
Percent males 5–14	–4.24	–2.64*	–0.06	–0.03
Percent males 15–19	0.58	0.28	6.95	2.93*
Percent males 20–34	–0.03	–0.02	4.69	2.09*
Percent males 35–54	0.30	0.13	2.18	0.78
Percent males 55+	–0.47	–0.16	2.58	0.77
Percent females 0–4	–3.63	–2.18*	–0.28	–0.13
Percent females 5–14	–3.03	–1.87*	–2.19	–1.09
Percent females 15–19	–0.79	–0.36	–3.68	–1.33
Percent females 20–34	1.14	0.51	1.75	0.63
Percent females 35–54	–0.49	–0.22	2.76	1.01
Percent females 55+	–1.86	–0.81	–1.80	–0.65
Household size	23.95	3.18*	15.39	1.73*
Household has educated female	84.65	2.65*	126.10	3.37*
Household has educated male	–1.07	–0.03	–90.78	–2.19*
Pre-flood asset value (Tk thousand)	6.53	2.69*	6.53	2.28*
Age	33.48	15.29*	59.27	22.84*
Age-squared	–0.44	–13.56*	–0.72	–19.08*
Flood exposure				
Moderate	–138.18	–2.82*	–263.21	–4.41*
Severe	–90.69	–1.79*	–242.38	–3.96*
Very severe	–116.73	–2.09*	–175.96	–2.64*
R^2	.169		.316	
Prob > *F*	0.000		0.000	
Significance of village effects (*p*-value)	.000		.000	
Number of observations	1,613		1,647	
Number of villages	117		117	

Source: IFPRI-FMRSP, Household Survey 1998 and authors' calculations.

Note: The dependent variable is grams of cooked rice + grams of cooked wheat.
* denotes that the coefficient is statistically significant at the 10% level or less.

to the average proportion for all members of their household. If the person's proportion is greater than the average for a particular food (*IRCS* > 1), they are considered favored in the consumption of that food; if it is less (*IRCS* < 1), they are disfavored.[61] A third measure of whether or not male favoritism exists in a household can then be con-

[61] More formally, the individual relative consumption share of any household member $i = 1, \ldots, n,$ for food $j = 1, \ldots, k,$ where k is the number of foods in the diet, is defined as:

$$ICRS_j^i = \frac{\dfrac{X_j^i}{\sum_{j=1}^{k} X_j^i}}{\dfrac{\sum_{i=1}^{n} X_j^i}{\sum_{i}^{n}\sum_{j}^{k} X_j^i}}, \; j = 1, \ldots k; \; i = 1, \ldots, n.$$

This differs from Bouis et al.'s (1998b) measure, called "Food share over energy share" (FE/ES), in two ways: (a) the numerator of the FS/ES measure is the individual proportion of total household consumption of a food and the denominator is the individual proportion of total household consumption of all foods combined; (b) the FS/ES measure uses calories in the denominator ratio under the presumption that households will maintain relative equality in hunger satiation across their members. We cannot do that here because we have information only on the dishes, for which a calorie conversion is not possible, rather than on the foods. In the absence of the difference due to (b), the two measures are mathematically equivalent.

Table 5.9 Gender differences in consumption of animal products

Foods	Consumption incidence in consuming households		Individual relative consumption share		Households with male favoritism (%)
	Female	Male	Female	Male	
Fish	93.4	93.9	1.011	1.05	51.7
Meat, eggs, and milk	64.0	80.0*	0.810	1.26*	59.9
Number of people	371	401	371	397	
Number of households					157

Source: IFPRI-FMRSP, Household Survey 1998 and authors' calculations.

* denotes that the female–male difference is significant at the 1% level (two-tailed test).

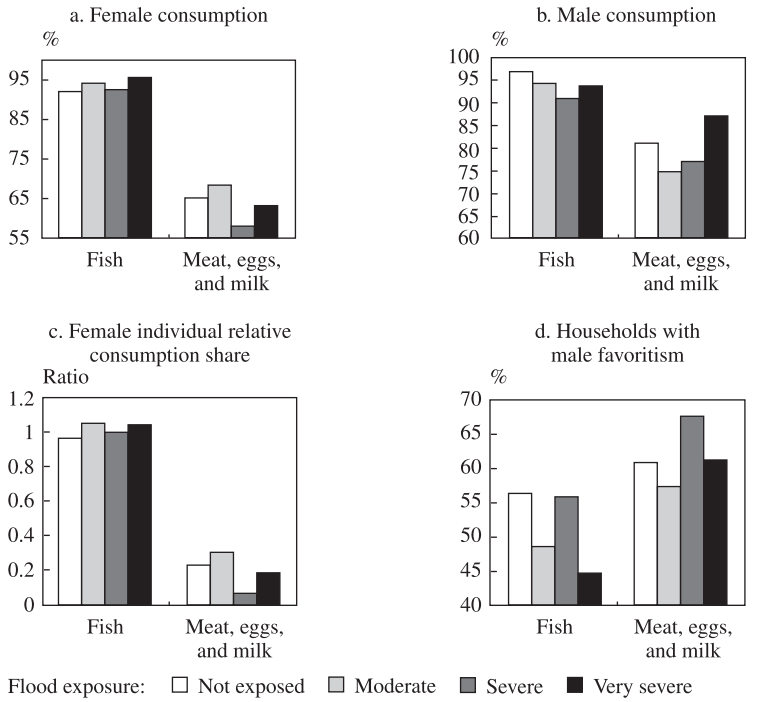
structed, equaling 1 if the average male IRCS is greater than the average female IRCS, and zero otherwise.[62]

Table 5.9 reports summary statistics on the three measures. Since discrimination can be detected only in households where a food is consumed, the measures are reported only for consuming households. Gender differences in the incidence of fish consumption are negligible. However, males are much more likely than females to consume milk, eggs, and meat. With an IRCS close to 1.0 for both males and females, there is little gender discrimination in the consumption of fish. However, for meat, eggs, and milk, the female IRCS is considerably below 1 and the male IRCS considerably above. Male favoritism in the consumption of these foods—or discrimination against females—exists in 60 percent of households.

Did the floods lead to any *increase* in gender discrimination in the consumption of the preferred animal products? Figure 5.4 compares the three measures across individuals and households in the flood exposure groups. Starting with fish, whereas the female consumption incidence increases slightly across the groups (5.4(a)), the male consumption incidence declines (5.4(b)). The female IRCS for fish increases (5.4(c)), with a corresponding decline in the percentage of households with male favoritism in fish consumption, from 56 percent in non-exposed households to 50 percent in exposed households as a group (5.4(d)).

For meat, eggs, and milk, the female consumption incidence rises with moderate ex-

Figure 5.4 Comparison of three measures of intrahousehold food distribution across non-flood-exposed and flood-exposed households



Source: IFPRI-FMRSP, Household Survey 1998.

[62] Given the nature of the data employed, the conclusions with respect to consumption of individual foods using these measures are based on the assumption that the proportion a person eats of a food is equal to the proportion they eat of the dish containing it.

Table 5.10 Impact of flooding on gender-based discrimination in consumption of fish, meat, eggs, and milk: Summary of regression results

	Likelihood of consuming protein food[a]				Likelihood of male favoritism[b]	
	Female		Male			
Flood exposure	Odds ratio	*z*-statistic	Odds ratio	*z*-statistic	Odds ratio	*z*-statistic
Fish						
Moderate	1.59	1.24	1.35	0.75	0.84	–0.42
Severe	0.75	–0.96	0.53	2.01*	0.74	–0.69
Very severe	0.78	–0.66	0.60	–1.38	0.38	–2.06*
Prob > χ^2	0.47		0.08		0.07	
Number of people	1,170		1,203			
Number of households					458	
Meat, milk, and eggs						
Moderate	1.55	1.31	0.77	–0.75	0.92	–0.13
Severe	1.08	0.27	0.83	–0.57	0.30	–2.14*
Very severe	1.14	0.33	1.87	1.15	1.43	0.44
Prob > χ^2	0.02		0.35		0.00	
Number of people	369		396			
Number of households					53	

Source: IFPRI-FMRSP, Household Survey 1998 and authors' calculations.

[a] Village-level flood exposure.
[b] Household flood exposure with village fixed effects.
* denotes that the coefficient is statistically significant at the 10% level or less.

posure but then declines with severe and very severe exposure. The male incidence falls but then rises for the very severe group. The female IRCS shows a consistent declining trend. There is a corresponding increase in the percentage of households with male favoritism. These descriptive results suggest no increase in discrimination against females in the consumption of fish (and perhaps a decrease) but a slight increase in discrimination in the consumption of the meat, eggs, and milk, which are among the most preferred foods.

Table 5.10 presents the results of the logit model, in which we examine whether the same findings are evident when individual, household, and village characteristics are controlled for. The dependent variables are (1) whether or not an individual consumed the food, for both males and females,[63] and (2) whether or not male favoritism in the consumption of the food exists in a household. Because of insufficient variation in consumption incidences among individuals of the same gender within villages, it is possible to employ only the village-level flood exposure measure in these regressions. The household-level flood exposure measure is employed in male favoritism regressions.

The results confirm that the male likelihood of consuming fish declined as a result of the floods, but only in severely exposed villages. They indicate no change in the female likelihood. Further, the likelihood of male favoritism in the consumption of fish declined for very severely exposed households. In the case of meat, eggs, and milk, the regression results detect no change in the consumption incidences for either females or males. However, they detect a decline in male favoritism in the consumption of these foods in severely flood-exposed households, contrary to the pattern of Figure 5.4(d).

[63] In addition to the independent variables included in previous regressions, here we include the age and age-squared of the individual.

Table 5.11 Health environment characteristics, by severity of flood exposure

	Flood exposure				
	Not exposed	Moderate	Severe	Very severe	All households
Shelter and living environment					
Height of water in home during 1998 floods (feet)	0.0	1.2	2.5	4.5	1.9
Height of water in home during 1997 floods (feet)	0.0	0.1	0.1	0.1	0.1
Height of water in homestead during 1998 floods (feet)	0.0	1.4	2.4	3.6	1.8
Days water in home during 1998 floods	0.0	14.2	32.5	61.0	25.5
Experienced damage to home (% of households)	5.1	45.6	61.0	72.4	43.9
Percent value of home lost due to floods	1.3	11.0	16.5	23.3	12.4
Percent of households forced to leave home due to floods	0.0	11.5	20.8	41.7	17.4
Average number of days displaced due to floods	0.0	2.9	6.2	20.6	6.9
Safe water[a]					
Obtain drinking water from tubewell (% of households)	98.2	95.1	97.6	95.2	97.0
Obtain cooking water from tubewell	82.0	52.4	36.2	27.0	50.9
Obtain washing water from tubewell	62.2	36.6	31.4	31.0	41.3
Water source is outside of home (% of households)	53.0	68.3	65.1	61.5	38.5
Distance to out-of-home water source (feet)	70.0	78.0	69.0	89.0	76.0
Time taken to collect water per day (hours)	0.93	1.17	1.20	1.30	1.15
Amount of water collected (liters)	60.1	47.3	50.2	50.4	51.9
Sanitation					
Household has sanitary latrine[b]	29.0	25.3	21.8	18.3	23.9
Number of households[c]	217	165	207	168	757

Source: IFPRI-FMRSP, Household Survey 1998 and authors' calculations.

[a] Tubewells are the only source of safe water available to the large majority of rural residents. The other sources (not safe) are ponds, rivers, and canals.
[b] A sanitary latrine is one that is sealed to prevent waste from spreading into the surrounding environment (traditional pit toilet, water-sealed slab latrine, or facility with septic tank).
[c] Some of the variables have a small number of missing cases.

These findings, taken together, suggest that the 1998 floods were associated with (a) a slightly greater decline in the consumption of the main staples, rice and wheat, among men than among women; (b) a decline in discrimination against females in the consumption of fish, a widely consumed preferred food; and (c) a possible increase in discrimination against females in the consumption of meat, eggs, and milk, foods that are preferred by not widely consumed. This means that the floods led to no significant, widespread increase in discrimination against females in intrahousehold food distribution. This is not to say that such discrimination did not continue to exist in the aftermath of the floods, only that its degree did not change significantly as a result of the floods.

Health Environment and Illness

In this section we describe people's health environment during the floods and in the immediate post-flood period, including the state of their shelter and daily living environment, access to safe water, and state of sanitation. We ask whether the floods led to a deterioration in the quality of the health environment in and surrounding people's homes. We then turn to look at the impact of the floods on people's health.

Health Environment

Most rural Bangladeshi people live in homes that are by their very nature structurally vulnerable to flood damage, with walls made of jute, bamboo, or mud, and with earthen or bamboo floors (Mitra et al. 1997). The average flood-exposed household in the study sample had 2.7 feet of water in the house, rising to 4.5 feet for the very severely exposed households, far above the previous year's level of 0.1 feet (see Table 5.11). The average very severely exposed household had water in the home for over two months, and almost three-quarters experienced dam-

age to their home during the floods. Even moderately exposed households had much more water in their home than in the previous year, and 45 percent had damage to their home.

Under these conditions, many people were directly exposed to floodwaters—and the pathogens they contain—on a daily basis. The amount of time and energy devoted to caring for young children and protecting household possessions, including animals, was greatly increased. Carrying on regular activities, such as cooking, eating, cleaning, going to work or school, and even sleeping, became more difficult. Many people's homes were so unlivable that they were forced to leave, relocating to either a raised road, a government or NGO shelter, or another home (HKI 1998a). Among the flood-exposed sample households, 24 percent had members who were displaced during the flooding. This number rose to 42 percent for very severely exposed households, with the average amount of time displaced being three weeks.

One of the most important elements of a proper health environment is access to adequate safe drinking water. Most households in rural Bangladesh normally get their drinking water from tubewells, the safest water source available (Mitra et al. 1997). Other major sources of water are ponds, rivers, or canals. Flood field reports indicate that many households' tubewells were damaged or contaminated with floodwater during the floods. However, many people were aware of the need for safe water to avoid illness and carried water to their homes from undamaged tubewells—often traveling great distances to do so. Others drank dirty water either because they could not find any clean water or because they lacked the knowledge or ability to treat it. In some cases, tubewells that had been contaminated were not disinfected; in others, people drank contaminated water because fuel was too wet to boil it (BHC 1998; WFP 1998; Hossain and Shuaib 1998; Islam 1998).

As shown in Table 5.11, during the time of the survey in November 1998, most households had been able to maintain tubewells as their main source of drinking water. However, use of tubewell water for cooking and washing dropped precipitously across the flood exposure severity groups. Further, the proportion of households obtaining water outside of their home rose from 53 percent of non-exposed households to 62 percent of very severely exposed households. The time spent collecting water increased from just under one hour for non-exposed households to about an hour and a quarter for the severely exposed households. Consequently, the amount of water collected dropped from 60 to 50 liters across these two groups. These numbers indicate that safe water from tubewells was still scarce and more difficult to obtain than usual even after the floodwaters receded. Note that the large majority of the water collected is by females: 20.8 percent by adolescent girls and 70.7 percent by adult women.

With regard to sanitation, in normal circumstances most Bangladeshi households either rely on open latrines, in which waste is not prevented from spreading into the surrounding environment, or have no sanitation facility at all (30 percent). The rest use more hygienic, closed latrines, either traditional pit toilets, water-sealed slab latrines, or modern facilities with septic tanks (Mitra et al. 1997). Flood field reports indicate that during the floods many open latrines had filled with water and were overflowing, and that many closed latrines were destroyed (BHC 1998; HKI 1998a). Table 5.11 shows that the share of sample households with closed (sanitary) latrines in fact declined across the flood exposure severity groups, from 29 percent of non-exposed households to 18 percent of those very severely exposed.

Illness

The floods were thus associated with a major deterioration in the quality of households' health environments, both during the actual

Table 5.12 Prevalence of any illness, diarrhea, respiratory illness, and fever, by severity of flood exposure

		Flood exposure			
	Not exposed	Moderate	Severe	Very severe	All
Any illness	23.03	25.89	34.79	39.43	30.72
Diarrhea	8.17	5.50	11.74	12.73	9.64
Respiratory illness	1.86	4.24	5.87	7.05	4.70
Fever	6.41	8.25	10.56	10.80	9.00
Number of people	1,077	873	1,193	880	4,023

Source: IFPRI-FMRSP, Household Survey 1998.

flooding period itself and continuing into the following months. Common flood-related illnesses, such as diarrhea,[64] acute respiratory infections, and skin lesions did not reach acute or epidemic proportions during the floods. There was concern, however, that illnesses would become more widespread when the floodwaters receded owing to increased water contamination (Hossain and Shuaib 1998; Khan and Haque 1998; Islam 1998). The analysis of this section shows that this was indeed the case.

Table 5.12 reports the percentage of people in the survey households experiencing an illness in the previous two weeks by severity of flood exposure, in addition to prevalences of the three most commonly reported illnesses: diarrhea, respiratory illness, and fever. About 30 percent of people had been sick, and diarrhea (10 percent) and fever (9 percent) were the most common illnesses. The prevalences of all the illnesses rose precipitously across the four flood exposure severity groups. Only 23 percent of people in non-exposed households were sick in the two weeks prior to the survey. The prevalence in the moderately exposed group was only slightly higher (26 percent), but in very severely exposed households it jumped to 40 percent. The greatest increase associated with flood exposure occurred in respiratory illness, whose prevalence tripled across the non-exposed (1.86 percent) and exposed (5.74 percent) groups. The incidence of fever rose by 55 percent and that of diarrhea by 25 percent over the two groups. These numbers indicate that the floods left quite a large increase in morbidity in their wake.

Table 5.13 reports logit model results for illness risk in the floods' aftermath using the village-level measure of flood exposure.[65] A person living in a village that was moderately exposed to the floods had an increased risk of contracting an illness of about one-third. The increased risk was almost double for people in severely exposed villages and greater than two and a half times for people living in very severely exposed villages. In terms of individual illnesses, a person living in a severely exposed village had a 1.6 times increased chance of contracting diarrhea, a doubled risk of contracting a respiratory illness, and an almost doubled risk of contracting a fever. For very severe exposure the diarrhea risk more than doubled, the respiratory illness risk tripled, and the fever risk nearly tripled as well. Confirming the descriptive results, the risk rose the most for respiratory illness. Note that, when the household flood exposure measure is employed, the results are largely statistically insignificant. This suggests that targeting of health

[64] Diarrhea among children was reportedly quite high during the flood period itself, with the situation being classified as an "outbreak" (see BHC 1998; Hossain and Shuaib 1998; and Islam 1998).

[65] When the household flood exposure measure with village fixed effects is employed, the results are largely statistically insignificant except for respiratory illnesses.

Table 5.13 Determinants of prevalence of any illness, diarrhea, respiratory illness, and fever: Regression results (village-level flood exposure logit model)

	Any illness		Diarrhea		Respiratory illness		Fever	
	Odds ratio	*z*-statistic	Odds ratio	*z*-statistic	Odds ratio	*z*-statistic	Odds ratio	*z*-statistic
Female-headed household	1.29	0.97	1.36	0.82	0.59	–0.66	0.88	–0.31
Age of household head	1.00	–0.81	1.00	0.09	0.99	–1.01	0.99	–0.92
Percent males 5–14	0.98	–3.53*	0.99	–1.78*	0.97	–4.15*	0.99	–1.53*
Percent males 15–19	0.98	–3.80*	0.99	–1.64	0.99	–0.72	0.98	–2.18*
Percent males 20–34	0.98	–3.66*	0.99	–1.59	0.97	–2.87*	0.98	–2.30*
Percent males 35–54	0.99	–1.66*	0.98	–1.62	0.98	–1.08	0.99	–1.20
Percent males 55+	0.98	–1.89*	0.98	–1.78*	1.01	0.33	0.99	–1.00
Percent females 0–4	0.99	–2.30*	1.00	0.63	0.98	–2.70*	0.99	–2.08*
Percent females 5–14	0.98	–3.84*	1.00	–0.66	0.97	–2.96*	0.99	–1.16
Percent females 15–19	0.98	–2.92*	0.99	–1.36	0.98	–1.39	0.99	–0.94
Percent females 20–34	0.98	–2.43*	0.99	–0.62	1.00	0.11	0.99	–0.87
Percent females 35–54	0.98	–2.87*	0.99	–1.05	0.97	–2.03*	1.00	–0.52
Percent females 55+	0.98	–3.91*	0.98	–1.73*	0.96	–3.01*	0.99	–1.02
Household size	0.91	–4.35*	0.90	–2.84*	0.97	–0.69	0.85	–4.12*
Household has educated female	0.99	–0.08	1.15	1.01	0.56	–3.20*	0.98	–0.12
Household has educated male	0.89	–1.30	1.00	–0.01	1.29	1.31	0.75	–2.04*
Total pre-flood asset value (Tk thousand)	1.01	1.89*	1.00	0.37	1.00	–0.07	1.03	3.47*
Age	0.99	–1.19	0.96	–5.24*	0.93	–5.83*	1.01	1.54
Age-squared	1.00	3.08*	1.00	5.51*	1.00	5.11*	1.00	–0.65
Sex	1.08	1.06	0.85	–1.34	1.02	0.09	0.96	–0.39
Flood exposure								
Moderate	1.30	2.53*	1.16	0.88	0.92	–0.32	1.35	1.74*
Severe	1.88	6.88*	1.57	3.14*	2.01	3.32*	1.86	4.07*
Very severe	2.77	9.30*	2.15	4.70*	3.28	5.36*	2.82	6.17*
Pseudo R^2	.044		.041		.0976		.0472	
Prob > χ^2	0.000		0.000		0.000		0.000	
Number of observations	4,007		4,007		4,007		4,007	

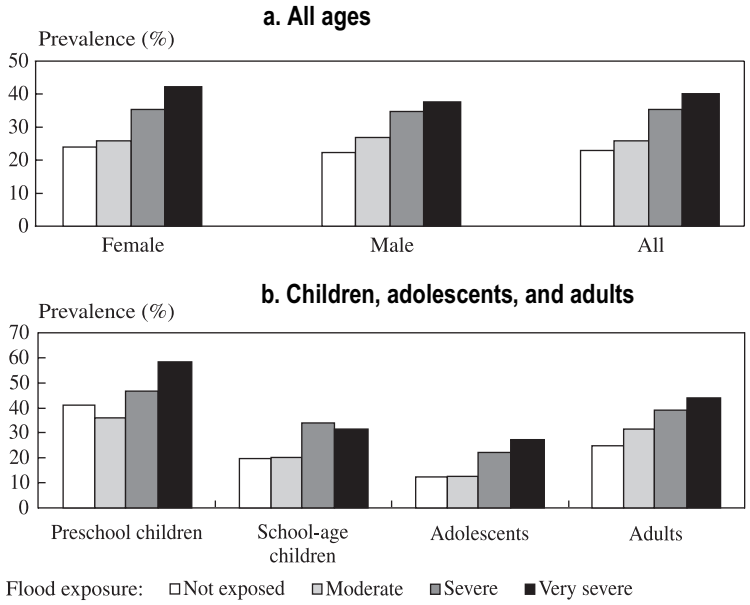
Source: IFPRI-FMRSP, Household Survey 1998 and authors' calculations.

* denotes that the coefficient is statistically significant at the 10% level or less.

interventions to flood-exposed villages (rather than to individual households) is an efficient mechanism for addressing health needs in the aftermath of covariate shocks such as the floods.

Figure 5.5 shows the prevalence of illness across flood exposure severity groups by age group and gender. Strong gender differences in the impact of flood exposure for the sample as a whole are not apparent. All age groups exhibit a pattern of increased illness with greater severity of flood exposure. Table 5.14 compares the flood exposure odds ratios derived from logistic regression for children (0–10 years), adolescents (10–18), and adults (18 and over) in the sample. All adults living in flood-exposed villages experienced increased illness risk. Adolescents living in very severely exposed villages were over three and a half times more likely to contract an illness than those living in non-exposed villages. Children in severely exposed villages had a slightly increased illness risk, and for those in very severely exposed villages the risk more than trebled. Thus, although adolescents experienced the greatest increase in illness risk due to the floods, the consequences of illness among children are more serious than among either adolescents or adults, since illness can put a child's life in danger. Acute respiratory infections and diarrhea, in particular, are major contributors to child mortality in Bangladesh (Mitra et al. 1997). Thus the heightened illness among

Figure 5.5 Prevalence of any illness in previous two weeks, by gender, age group, and severity of flood exposure



Source: IFPRI-FMRSP, Household Survey 1998.

Table 5.14 Impact of flood exposure on prevalence of any illness for children, adolescents, and adults: Summary of regression results (village-level flood exposure logit model)

	Odds ratio	*z*-statistic
Children		
Flood exposure		
Moderate	1.23	0.99
Severe	1.47	2.09*
Very severe	3.23	5.34*
Prob > χ^2	0.00	
Number of people	980	
Adolescents		
Flood exposure		
Moderate	1.50	1.42
Severe	2.68	4.02*
Very severe	3.53	4.43*
Prob > χ^2	0.00	
Number of people	909	
Adults		
Flood exposure		
Moderate	1.30	1.86*
Severe	2.02	5.50*
Very severe	2.64	6.23*
Prob > χ^2	0.000	
Number of people	1,983	

Source: IFPRI-FMRSP, Household Survey 1998 and authors' calculations.

Notes: Child regressions include parents' ages and education plus mother's height as regressors. All other regressions contain the same variables as listed in Table 5.13.
* denotes that the coefficient is statistically significant at the 10% level or less.

children represents the most serious health consequence of the floods.

Nutritional Status of Preschool Children and Women

Preschool Children

Bangladesh has some of the highest child malnutrition rates in the world. Even under normal conditions over half of all preschool children (0- to 5-year-olds) in the country are stunted, signaling that they have experienced long-term inadequate nutrition and/or poor health. Roughly 15 percent are wasted—having recently experienced substantial weight loss, usually owing to an acute shortage of food or a severe illness (ACC/SCN 2000; BBS 1997; Mitra et al. 1997).[66] Besides being a cause of much physical and emotional suffering, child malnutrition has long-term consequences for a country's overall development because it impairs cognitive ability, reduces productivity, and increases demands on social services. It is also a leading cause of death among young children (ACC/SCN 2000).

One of the reasons child malnutrition rates are so high in Bangladesh is the lack of proper caring practices for children, especially feeding practices (MHFW 1995; UNICEF 1998; UNICEF-ADB 1997). After six months of age, as well as continued breastfeeding, children need frequent nutritious meals free of pathogens in order to continue to grow and thrive. They also need extra feeding during and after illnesses (ACC/SCN 2000). Reports from the flood front in-

[66] A child is defined as wasted (stunted) if the child's weight-for-height (height-for-age) *z*-score is less than −2 standard deviations from the U.S. National Center for Health Statistics/World Health Organization international reference standard for the child's age. Severe wasting (stunting) is defined as a *z*-score of less than −3.

Table 5.15 Nutritional status of preschool children, adolescent girls, and nonpregnant women (percent)

	Preschool children	Adolescent girls and nonpregnant women
Wasting	23.5	
Severe	3.9	
Stunting	55.3	
Severe	24.0	
Body mass index		18.1
Chronic energy deficiency (%)		60.4
Severe chronic energy deficiency (%)		15.0
Number	409	654

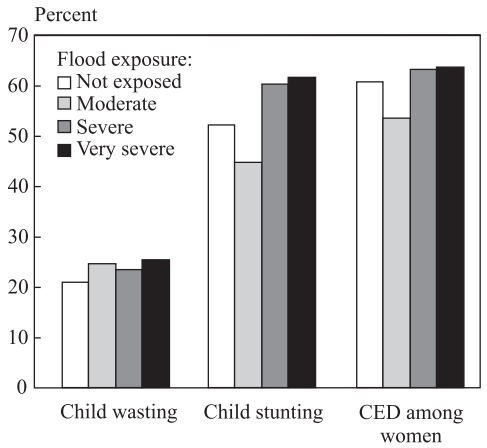
Source: IFPRI-FMRSP, Household Survey 1998 and authors' calculations.

dicate that fulfilling these special needs became quite difficult during the floods, which would be expected given the damage to homes and the increased efforts needed to obtain food and cook it, obtain safe water, and maintain a clean living environment. Some mothers had difficulty obtaining or preparing supplementary food for their children, and others were producing insufficient breastmilk owing to their own reduced food consumption. Children could not always be protected from the floodwaters and were exposed to contaminants in them or became ill from wearing wet clothes (del Ninno and Roy 1999a; Hena and Kabir 1998; Hossain and Shuaib 1998; Khan and Haque 1998; Rahman and Choudhury 1998). Not surprisingly, data collected during the flood months as part of Bangladesh's ongoing Nutrition Surveillance Project revealed a dramatic increase in wasting in the flood-affected areas of the country from June to August 1998, contradicting the normal pattern at that time of year (HKI 1998b).

The first column of Table 5.15 shows the nutritional status of preschool children in the study sample. In the period immediately following the recession of the floodwaters, 24 percent were wasted and 55 percent were stunted. The prevalence of wasting and stunting across the flood exposure severity groups is shown in Figure 5.6. The wasting rate rose from 21.0 percent for children living in non-exposed households to 25.3 percent for those living in very severely exposed households. The graph also indicates that the floods led to an increase in stunting among children in households severely and very severely exposed to the floods.[67]

The logistic regression results using the household-level flood exposure measure

Figure 5.6 Wasting and stunting among preschool children, and chronic energy deficiency among women, by severity of flood exposure



Source: IFPRI-FMRSP, Household Survey 1998.
Note: CED = chronic energy deficiency.

[67] It was somewhat surprising to notice an impact on the rates of stunting only a few months after the end of the floods. This is consistent with the findings of Helen Keller International (HKI 1998a, 1998b) and with our data, which report an increase in illness at the onset of the floods in July 1998.

Table 5.16 Determinants of wasting and stunting among preschool children: Regression results

	Wasting				Stunting[a]	
	Village flood exposure		Household flood exposure with village fixed effects		Village flood exposure	
	Odds ratio	*z*-statistic	Odds ratio	*z*-statistic	Odds ratio	*z*–statistic
Percent males 5–14	1.03	1.36	1.04	1.53	1.01	0.82
Percent males 15–19	1.04	1.19	1.10	1.93*	1.05	1.51
Percent males 20–34	0.98	–0.59	1.01	0.26	1.02	0.80
Percent males 35–54	1.02	0.81	1.05	1.27	1.00	–0.15
Percent males 55+	1.04	0.95	1.11	2.03*	0.95	–1.50
Percent females 0–4	1.01	0.62	1.01	0.45	1.04	2.31*
Percent females 5–14	1.04	1.96	1.07	2.24*	1.02	1.00
Percent females 15–19	1.07	2.06*	1.14	2.70*	1.00	0.01
Percent females 20–34	1.05	1.37	1.09	1.81*	1.05	1.67*
Percent females 35–54	1.01	0.31	1.00	–0.04	1.02	0.76
Percent females 55+	1.04	1.37	1.08	1.81*	1.00	–0.16
Household size	0.85	–1.66*	0.89	–0.77	1.13	1.56
Mother's height	1.01	0.22	1.01	0.19	0.90	–4.37*
Mother's age	1.05	1.18	1.09	1.58	1.04	0.96
Father's age	0.94	–1.80*	0.95	–1.29	1.00	0.01
Mother has any education	0.89	–0.38	0.65	–0.90	0.70	–1.28
Father has any education	0.90	–0.34	1.10	0.18	0.97	–0.10
Pre-flood asset value (Tk thousand)	1.00	–1.15	0.96	–0.80	0.98	–0.85
Age (months)	1.03	0.79	1.02	0.41	1.10	3.33*
Age-squared	1.00	–0.93	1.00	–0.50	1.00	–2.85*
Gender	0.36	–2.21*	0.42	–1.80*	0.42	–2.18*
Flood exposure						
Moderate	1.14	0.37	2.90	1.26	0.69	–1.15
Severe	0.72	–0.96	7.30	2.25*	0.90	–0.36
Very severe	0.92	–0.22	4.87	1.76*	2.18	2.04*
Pseudo R^2	.080				.144	
Prob > χ^2	0.094		0.079		0.000	
Number of children	384		247		384	
Number of villages			60			

Source: IFPRI-FMRSP, Household Survey 1998 and authors' calculations.

[a] When this regression is undertaken using household-level flood exposure and village fixed effects, the observations from 34 villages and 78 households are dropped because there is no variation across households within villages in the dependent variable. When the household flood exposure measure without village fixed effects is employed, the flood exposure variables are insignificant except for the moderate exposure dummy, which has a coefficient (odds ratio) of less than one.

* denotes that the coefficient is statistically significant at the 10% level or less.

(Table 5.16) confirm that the floods led to a big increase in wasting that remained even after the floodwaters receded.[68] A child living in a household that was severely exposed to the floods had a seven times greater risk of being wasted than one not exposed at all. The increased risk was still quite large for very severe exposure (almost five times greater risk). This indicates that to respond to wasting it is necessary to target individual households rather then relying on village targeting. An example of an intervention would be extra support for lactating mothers and ensuring easily prepared supplementary foods are available for flood-exposed households with preschoolers.

The last column in Table 5.16 presents the results for stunting using the village-level flood exposure measure. They confirm that the floods led to a significant increase in

[68] Note that the regression coefficients on the flood exposure variables are not significant when the village-level flood exposure measure is employed.

Table 5.17 Determinants of chronic energy deficiency (CED) among nonpregnant women: Regression results

	Village flood exposure		Household flood exposure with village fixed effects	
	Odds ratio	*z*-statistic	Odds ratio	*z*-statistic
Female-headed household	0.99	–0.02	0.93	–0.11
Age of household head	0.99	–0.94	1.01	0.52
Percent males 5–14	1.00	0.00	1.00	–0.10
Percent males 15–19	1.00	0.15	0.98	–1.08
Percent males 20–34	0.99	–1.05	0.98	–0.94
Percent males 35–54	1.00	–0.02	0.99	–0.50
Percent males 55+	1.00	0.03	0.97	–1.06
Percent females 0–4	1.00	0.39	1.00	–0.08
Percent females 5–14	0.99	–1.25	0.97	–2.09*
Percent females 15–19	1.01	0.38	0.99	–0.32
Percent females 20–34	0.97	–2.01*	0.95	–2.74*
Percent females 35–54	0.99	–0.34	0.98	–1.11
Percent females 55+	1.01	0.50	0.98	–0.99
Household size	0.93	–1.33	0.84	–2.35*
Household has educated female	0.95	–0.25	1.08	0.30
Household has educated male	0.78	–1.13	0.69	–1.40
Pre-flood asset value (Tk thousand)	0.95	–3.49*	0.95	–2.71*
Age	0.75	–2.48*	0.75	–2.05*
Age-squared	1.00	2.70*	1.00	2.12*
Flood exposure				
Moderate	0.917	–0.368	0.519	–1.742*
Severe	1.345	1.361	0.476	–1.784*
Very severe	1.162	0.553	0.390	–1.968*
Pseudo R^2	.072			
Prob > χ^2	0.000		0.003	
Number of people	650		561	
Number of villages			97	

Source: IFPRI-FMRSP, Household Survey 1998 and authors' calculations.

* denotes that the coefficient is statistically significant at the 10% level or less.

stunting for children living in very severely exposed villages.[69] The impact of the floods on stunting is not surprising because most of the children that lived in more severely exposed villages suffered the consequences of poor sanitation at the onset of the floods in July 1998, four months before the survey.

Women

As noted above, the nutritional status of Bangladeshi women is also extremely poor. Bangladesh has the world's highest known rate among women of chronic energy deficiency (CED)—signifying that a person is underweight owing to insufficient energy intakes.[70] Malnutrition of women in turn leads to intrauterine growth retardation and low birthweight babies. It also hinders mothers from providing adequate care to children after they are born (ACC/SCN 2000). The prevalence of CED among nonpregnant women aged 19–49 years in the study sample is 60 percent (Table 5.15).[71]

[69] The household-level measure of flood exposure could not be employed in the regression for stunting owing to insufficient variation in stunting across children in villages.

[70] A person is classified as being chronically energy deficient if her or his body mass index (weight divided by height-squared) is less than 18.5. A person is severely energy deficient if his or her BMI is less than 16.

[71] For comparison, the percentage of nonpregnant women aged 15–49 in Bangladesh among women with children under five years of age is reported by Mitra et al. (1997) to be 52 percent. It is reported in ACC/SCN (2000) to be 51.3 percent for women aged 20–49. These numbers are calculated using the 1996–97 Bangladesh Demographic and Health Survey.

Figure 5.6 also shows the prevalence of CED across the flood exposure severity groups. Although it drops for moderate exposure, it is slightly elevated for severe and very severe flood exposure. Logistic regression results for CED risk are reported in Table 5.17. The results when the village-level flood exposure measure is employed suggest that a woman living in a flood-exposed village had no greater risk of becoming undernourished than those living in non-exposed villages. When the household-level flood exposure measure is employed, the results suggest that the floods led to a *decline* in undernourishment among women in households in all three flood exposure categories, although these results are not strongly significant. In conclusion, we found no evidence that the floods had a negative impact on women's nutritional status.

Summary

The 1998 floods in Bangladesh reduced people's food consumption. It also compromised households' ability to meet their food needs on a sustainable basis; in other words, it increased food insecurity. We have found that households exposed to the floods probably experienced reduced food consumption during the flood period itself, and the majority continued to consume less food than usual even after the floodwaters receded.

In an effort to maintain normal consumption of other foods whose prices had increased, households reduced their consumption of rice (substituting some with wheat). They also reduced their consumption of three non-staple foods: micronutrient-rich vegetables and fruit, whose prices remained higher than normal owing to continued scarcities, and milk. These changes in their consumption baskets resulted in a reduction in the level of calories consumed and increased the number of households characterized as questionable in terms of food security (that is, they consumed less than 1,818 calories/person/day but spent less than 70 percent of their budgets on food). Per capita calorie consumption of households not exposed to the floods was on average 160–200 calories per person higher than for households severely or very severely exposed to the floods. Other immediate needs in the post-flood period may have prevented the questionable households from increasing their spending on food, however. We found no evidence that the floods led to any widespread increase in discrimination against females in food consumption within households. This is not to say that females are not discriminated against, only that its degree did not change significantly as a result of the floods.

The floods led to a major deterioration in the quality of households' health environments. They damaged or destroyed people's homes, reduced their access to safe water, and destroyed or damaged their toilet facilities. These factors, combined with the reduction in food consumption, led to substantial increases in illness among all age groups. Although adolescents had the greatest increase in illness, the increase in illness among children was an even more serious health problem posed by the floods because illness has more serious consequences for children, even threatening their survival.

We also confirmed that the floods caused many preschool children to lose weight and/or to fail to grow at a critical period in their physical and mental development. This situation was brought about by a combination of factors, including reduced food consumption, increased difficulties of providing proper care for children owing to disruptions in home life, and increases in child illness. We found no evidence that the floods were harmful to women's nutritional status, at least in their immediate aftermath.

Our findings that caloric consumption and other health outcomes were affected by flood exposure measures at village level are an indication that interventions at the village level could have been effective in reducing the adverse impact of the floods. On the other hand, the degree of individual household flood exposure was a significant determinant of individual consumption of staple foods and of wasting, suggesting a possible positive impact of individual targeting in these cases.

CHAPTER 6

Household Coping Strategies

When households suffer a shock such as the floods, they do not remain passive but employ several coping strategies. These coping strategies are fallback mechanisms for when habitual means of meeting needs are disrupted (Frankenberger 1992).

The first thing households do when they suffer a shock is to attempt to minimize risks and manage losses to ensure some minimal level of sustenance. The second strategy employed by households in distress is divestment, or the gradual disposal of assets. Frankenberger (1992) classifies asset disposal as a coping strategy into several phases, with liquid assets, such as jewelry, being disposed of first, and productive assets later. When productive assets are disposed of, it becomes more difficult for the person or household to return to a pre-crisis state. Finally, the household or individual may embark upon distress migration, which is a sign of failure to cope with the crisis.

This chapter looks at the kinds of coping strategies that were employed by people during the floods of 1998 and in their immediate aftermath. We first report the strategies mentioned by flood-exposed people both in the field interviews of a rapid appraisal done by the Food Management and Research Support Project of the International Food Policy Research Institute (IPFRI-FMRSP) during the floods (del Ninno and Roy 1999a) and in other similar studies. Using the household survey, we then quantify some of the coping strategies employed by rural households in Bangladesh to see how widespread they were and whether they were directly associated with flood exposure.

Self-Reported Coping Strategies

At the time of the floods and soon after, several rapid appraisal missions were conducted by the FMRSP-IFPRI project and by several other organizations. The main goal was to understand the extent of the damage caused by the flooding, how well people were doing in the circumstances, and the type of coping strategies that had been employed. The ultimate purpose of those field visits was to improve the immediate alleviation policies that were designed at the time of the floods and in the immediate aftermath.

The results of the rapid appraisal show that the agricultural sector and the labor market were hit particularly hard by the floods. In most cases farmers could not plant their usual crops and did not have enough fodder to feed their livestock. In response to that situation farmers cultivated alternative crops and found alternative means of feeding their livestock.

Table 6.1 Coping strategies employed by Bangladeshi people in response to the 1998 floods, self-reported in field surveys

Coping strategy employed	Study
Change agriculture and livestock practices	
Change cropping pattern	HKI a, b (1998)
Cultivate land on lease	Hossain and Shuaib (1998)
Use emergency fodder (e.g., jackfruit, tree leaves, sugarcane tops, banana stems, water hyacinth)	BHC (1998); Save the Children (1998)
Change employment or working pattern	
Become engaged in fishing (catch and sell) and boating or cutting long grass for cattle	WFP (1998); Save the Children (1998)
Advance labor	Khan and Haque (1998); HKI (1998)
Borrow money[a]	Democracy Watch (1998); HKI (1998)
From local money lenders	Khan and Haque (1998); Hena and Kabir (1998); WFP (1998); Rahman and Choudhury (1998); Hossain and Shuaib (1998); del Ninno and Roy (1999a)
From relatives or neighbors	WFP (1998); Rahman and Choudhury (1998); HKI (1998); IFPRI-Sat (1999)
From a nongovernmental organization	Rahman and Choudhury (1998); BHC (1998); del Ninno and Roy (1999)
Purchase rice on credit from a farmer	Khan and Haque (1998)
From a bank	BHC (1998); del Ninno and Roy (1999)
Change eating habits[b]	
Reduce food consumption, including size of meals	Khan and Haque (1998); Save the Children (1998); del Ninno and Roy (1999)
Reduce frequency of meals	WFP (1998); Save the Children (1998); del Ninno and Roy (1999)
Change types of food eaten, including eating jute leaves	Save the Children (1998)
Starve	Save the Children (1998)
Consume assets	
Eat seed reserves	BHC (1998)
Use fencing or roofing materials for cooking fuel	Khan and Haque (1998); WFP (1998)
Sell assets	
Domestic assets (e.g., tin from roof of house, furniture, trees, utensils, clothing)	del Ninno and Roy (1999); Banu and Hussain (1998); WFP (1998); Khan and Haque (1998); Democracy Watch (1998); HKI (1998)
Sell rice stocks to buy other essential commodities	IFPRI-Saturia (1998)
Sell means of transport	IFPRI-Saturia (1999); Banu and Hussain (1998); HKI (1998)
Sell livestock (cattle, buffalo, chicken, ducks, hens)	Khan and Haque (1998); Hena and Kabir (1998); Rahman and Choudhury (1998); HKI (1998); Save the Children (1998); del Ninno and Roy (1999); Banu and Hussain (1998); WFP (1998)
Sell jewelry	HKI (1998); Save the Children (1998); del Ninno and Roy (1999); Banu and Hussain (1998)
Sell or mortgage land	HKI (1998); Save the Children (1998); del Ninno and Roy (1999); WFP (1998)
Other	
Defer monthly installments on loans	WFP (1998)
Deplete savings	Democracy Watch (1998); HKI (1998); Save the Children (1998)
Have faith in God (Allah)	Save the Children (1998)
Move valuables to higher ground, especially cows and buffalo	Save the Children (1998); BHC (1998)
Float household items (for example, on banana leaves)	Save the Children (1998)

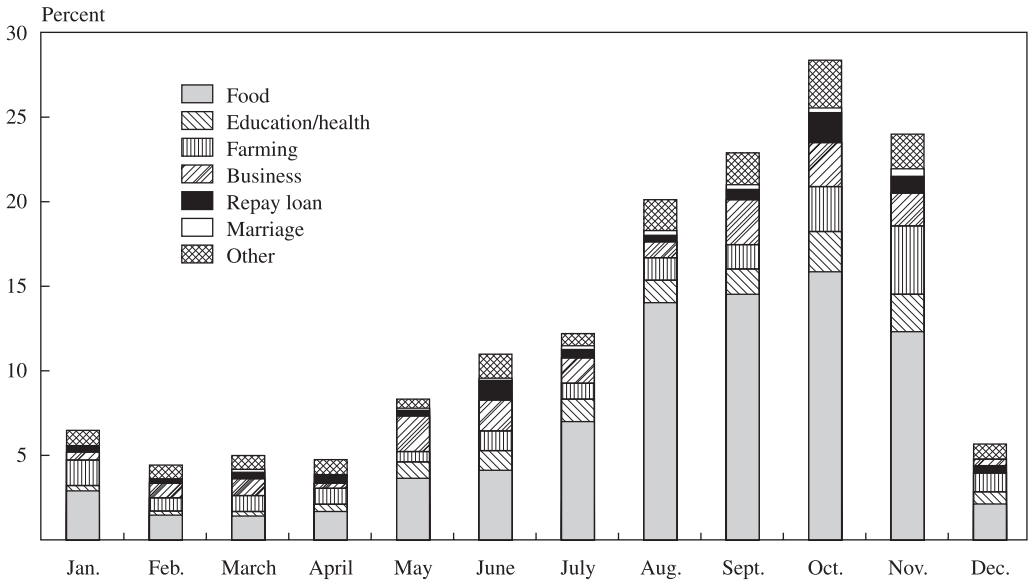
Sources: Compiled from the sources cited. IFPRI-Saturia (1999) denotes individual interviews in Saturia, January 1999.

[a] Credit uses: repair damage, buy seeds and food (BHC 1998).
[b] Women ate after men and children; sometimes they ate nothing (del Ninno and Roy 1999a).

Similarly, they found alternative forms of employment within the water sector, such as boating and fishing.

One key coping strategy mentioned by almost all studies is borrowing. According to the results of the interviews (summarized in Table 6.1), money was borrowed from all sorts of sources, including moneylenders, relatives, and neighbors. Purchasing of food on credit was also mentioned. Although purchasing food on credit is very common in several developing countries, extensive borrowing

Figure 6.1 Percentage of households taking loans, by month and reason in 1998



Source: IFPRI-FMRSP, Household Survey 1998.

is peculiar to Bangladesh and is explored later in the chapter.

Another coping strategy was a modification of eating habits and a reduction in the frequency of meals consumed when households suffered income loss and failed to get enough credit to purchase the same amount of food. The consumption and sale of domestic liquid assets and livestock assets were also reported as a way of meeting consumption needs. Finally, other forms of coping consisted of trying to protect assets and thus minimize losses from the floods, deferring loan payments, and using savings.

The Coping Strategies Identified by the Quantitative Analysis

Borrowing

The analysis of the household data set confirmed that borrowing was one of the main coping mechanisms used by households in response to the floods. The demand for financial credit during the flood period appears to have been extensive. The percentage of households that took a loan increased during the flood period for all uses taken together (Figure 6.1 and Table 6.2), but especially for food. The percentage of households who took a loan for food was only 7.0 percent in the month preceding the onset of flooding. By the last month of flooding (October) this had increased to 15.9 percent. By that time, more than 60 percent of households exposed to the floods had an outstanding loan of an average value of almost Tk 6,000, on loans contracted after July 1, 1998.[72]

The majority of the loans were contracted for purchasing food. In fact more than half of the poor households in the bottom two quintiles had outstanding loans for food for a value of almost Tk 3,000, which is close to the average amount spent in a month by a household to buy food. The percentage of households that had outstanding loans for other purposes was much lower, but the average size of the loans for farming and busi-

[72] There is usually an increase in borrowing in September and October, before the *aman* harvest, and in March and April, before the *boro* harvest, but it is clear that in 1998 the extent of borrowing had increased. In fact, as of January 1998 very few households had extensive debts, compared with December 1998, when many households were in debt.

Table 6.2 Percentage of flood-exposed households with outstanding loans taken after July 1, 1998, and average debt, by total expenditure quintile

	Quintile 1		Quintile 2		Quintile 3		Quintile 4		Quintile 5		All	
Reason	Percent of households	Average amount (Tk)	Percent of households	Average amount (Tk)	Percent of households	Average amount (Tk)	Percent of households	Average amount (Tk)	Percent of households	Average amount (Tk)	Percent of households	Average amount (Tk)
Food	52.2	2,954	54.9	2,645	46.2	3,205	32.7	3,132	38.3	5,201	45.2	3,328
Education/ health	12.4	990	5.3	1,235	6.6	3,228	9.9	2,730	5.6	4,900	8.0	2,339
Farming	6.2	8,733	3.5	5,255	7.5	2,656	9.9	6,087	15.0	9,613	8.3	7,068
Business	4.4	3,080	12.4	3,999	10.4	9,023	8.9	6,261	8.4	13,386	8.9	7,239
Repay loan	2.7	3,258	2.7	5,017	2.8	6,020	4.0	2,513	5.6	8,615	3.5	5,507
Marriage and dowry expenses	0.0	. . .	3.5	7,375	0.9	4,375	1.0	6,000	1.9	4,090	1.5	6,007
Others	11.5	4,271	6.2	6,318	3.8	2,406	12.9	5,702	9.3	9,251	8.7	5,872
All	66.4	4,400	69.9	4,268	62.3	5,034	55.4	6,036	61.7	10,141	63.3	5,868
Number of households	113		113		106		101		107		540	

Source: IFPRI-FMRSP, Household Survey 1998.

ness was larger (between Tk 3,000 and Tk 13,000) and they were more often contracted by households in the higher expenditure quintiles. It is interesting to observe that the average size of total outstanding loans was higher for people in the upper quintiles (Table 6.2). This may be due to greater access to credit by richer households, in part because they borrowed relatively large amounts for farming and business reasons. The reverse is true for poor households, which borrowed lower amounts and mostly for food consumption.

Households that were not exposed to the floods borrowed money as well, but not in the same proportion. Only 28 percent of households not directly exposed to the floods had outstanding loans for food during and following the floods. The average size of loans for all uses was higher for households not exposed to flooding. This was because the average size of loans for farming use was consistently higher than loans for food consumption use, regardless of the category of flood exposure.

Table 6.3 details the sources of loans and their interest rates by severity of flood exposure. Most of the loans were received from neighbors and relatives, with 23 percent of the households receiving loans from relatives and over 31 percent from neighbors. Other loan sources were NGOs, commercial banks and cooperatives, and local moneylenders (called *mahajans*).

Across the sample, interest rates ranged widely, from a low of zero to a high of 120 percent. Only 23 percent of loans were at zero interest rate. Neighbors and relatives were more likely not to charge any interest than the other sources. NGOs charged the lowest interest rates, while banks and cooperatives, *mahajans,* and neighbors charged annual interest rates of almost 50 percent on average.

It appears that people more exposed to the floods (Table 6.3) borrowed more, but they had more access to cheaper loans from NGOs and in general received more free loans and paid lower interest rates. These results suggest that, even though people in distress are usually willing to pay higher in-

Table 6.3 Loans taken, by source and severity of flood exposure (percent)

	Flood exposure														
	Not exposed			Moderate			Severe			Very severe			All		
Source	Loans taken	Loans at zero interest	Annual interest rate	Loans taken	Loans at zero interest	Annual interest rate	Loans taken	Loans at zero interest	Annual interest rate	Loans taken	Loans at zero interest	Annual interest rate	Loans taken	Loans at zero interest	Annual interest rate
Big NGO	3.7	0.0	15.8	5.5	0.6	11.1	3.4	0.0	12.4	6.0	0.0	12.4	4.5	0.1	12.9
Commercial bank/ cooperative	6.9	0.0	41.2	5.5	0.0	48.6	11.6	0.5	33.5	10.1	1.8	35.0	8.6	0.5	37.8
Mahajan	4.1	1.8	64.0	17.6	9.1	29.1	14.0	6.8	30.9	7.7	2.4	54.4	10.6	4.9	37.8
Neighbors	29.5	15.2	43.9	30.3	15.8	41.1	34.8	20.8	32.3	29.8	12.5	59.7	31.2	16.2	43.1
Relatives/ friends	18.4	11.1	26.4	22.4	11.5	41.7	24.2	15.0	19.6	28.0	19.6	22.1	23.0	14.1	26.5
All	53.5	21.2	36.1	62.4	23.0	38.4	62.8	23.2	28.9	65.5	25.6	40.1	60.6	23.1	35.5
Number of households	217			165			207			168			757		

Source: IFPRI-FMRSP, Household Survey 1998.

terest rates, not too many people took advantage of the situation. It also appears that informal sources of credit were more effective than traditional microcredit programs (as noted also in Zaman 1999) at providing households with the cash necessary to smooth consumption.

Purchasing Food on Credit

From the discussion above it is evident that loans for food were an important coping strategy for flood-exposed households. In addition to the loans for food, we also looked at the value of food that was purchased on credit in the month prior to the survey period. This is a reflection of a common practice of purchasing basic necessities on credit from local shops, which was confirmed in our analysis. Table 6.4 shows that almost 50 percent of all households purchased food on credit in the month of the survey for an average of Tk 998. Only 30 percent of the households not exposed to the floods purchased food on credit, compared with 57 percent of the households very severely exposed to the floods, which had to purchase rice, pulses, oil, and other products on credit.

Table 6.5 shows the pattern of food purchased on credit for flood-exposed households by expenditure quintiles. Although the percentage of people purchasing food on credit was slightly lower in the upper quintiles, they were able to obtain a larger amount of credit (Tk 1,336 in the top quintile), which could be used for more expensive foods compared with poorer people (Tk 774 in the bottom quintile).

Changing Eating Behavior

When a household has insufficient access to food, and faces other constraints, the primary persons responsible for feeding household members can do one or more of the following (Maxwell et al. 1999): (a) reduce the number of meals eaten in a day or go whole days without eating; (b) rely on less preferred and less expensive foods; and (c) limit portions at meal times.

We have already seen that households reduced their food consumption and limited their purchases of relatively expensive foods in response to the floods (Chapter 5). In order to determine whether they had reduced the number of meals eaten, households were

Table 6.4 Percentage of households purchasing food on credit and average amount purchased (in the month prior to survey), by food group and severity of flood exposure

	Flood exposure									
	Not exposed		Moderate		Severe		Very severe		All	
Type of food	Percent of house-holds	Mean value (Tk)	Percent of house-holds	Mean value (Tk)	Percent of house-holds	Mean value (Tk)	Percent of house-holds	Mean value (Tk)	Percent of house-holds	Mean value (Tk)
Rice	16.1	1,179	30.3	960	44	951	47.6	950	33.8	984
Wheat	2.3	203	13.3	200	16.4	270	13.7	221	11.1	234
Bread and other cereals	0.9	62	2.4	89	2.4	50	0.6	40	1.6	64
Pulses	4.1	38	12.1	136	27.1	122	20.2	124	15.7	119
Oil	7.4	79	16.4	98	28	78	25.6	102	19	89
Vegetables	10.1	86	12.1	133	16.9	134	16.7	176	13.9	135
Meat	0.5	160	0.6	53	4.3	106	5.4	165	2.6	132
Eggs	1.4	68	1.8	23	2.4	55	3	84	2.1	61
Milk	2.3	90	1.2	39	5.3	130	3.6	95	3.2	105
Fruits	0.5	12	1.2	40	4.8	62	4.8	53	2.8	54
Fish	1.4	47	1.8	147	6.3	160	6.5	288	4	194
Spices	4.6	49	9.1	226	16.4	168	14.9	153	11.1	160
Sugar and snacks	8.8	68	6.1	85	13.5	87	15.5	138	11	98
Drinks and other	0.9	136	1.8	163	9.2	222	11.3	106	5.7	163
Prepared foods	0.5	255	0.0	. . .	2.9	181	2.4	264	1.5	218
Total	29.5	768	44.8	895	59.9	1,055	57.1	1,158	47.3	998
Number of households	217		168		207		165		757	

Source: IFPRI-FMRSP, Household Survey 1998.

asked to report the number of meals each member had eaten in the three days prior to the survey. If a member skipped a meal, the respondent was asked why they had done so. The results are not reported for children under two years because most were breastfeeding and breastfeeding behaviors were not recorded in detail.

The incidence of meal skipping for the sample as a whole was 20 percent, which is quite high (Table 6.6). The incidence tended to increase with increased flood exposure severity, being 17 percent for the not exposed group and rising to 23 percent for the severely exposed group. It fell slightly between the severely and very severely exposed groups, to 20 percent, which may be a reflection of the latter group's greater access to aid from the government and NGOs. The most common reason by far given for skipping a meal was "not enough food." These figures verify that meal skipping was indeed part of the menu of coping strategies that some households employed in response to the scarcities brought about by the floods.

Disposal of Assets

Disposal of assets is often mentioned as a very important coping strategy for households exposed to shocks. In fact it is not uncommon for rural households to meet consumption requirements by consuming some of their assets or selling them in order to acquire the means to purchase other foods.

To isolate the impact of the floods, we compared the trend in disposal of assets in three periods: the period before the floods (December 1997 to June 1998), the period of the floods (July to October 1998), and the month after the floods (November 1998). Table 6.7 shows that more households sold assets during the floods (16.8 percent) than in the period before or after the floods. In particular, more households sold goats (1.9

Table 6.5 Percentage of flood-exposed households purchasing food on credit and average amount purchased (in the month prior to survey), by food group and expenditure quintile

	Quintile 1		Quintile 2		Quintile 3		Quintile 4		Quintile 5		All	
Type of food	Percent of households	Mean value (Tk)	Percent of households	Mean value (Tk)	Percent of households	Mean value (Tk)	Percent of households	Mean value (Tk)	Percent of households	Mean value (Tk)	Percent of households	Mean value (Tk)
Rice	44.3	687	45.1	1,028	40.6	992	41.6	1,017	32.7	1,097	40.9	953
Wheat	24.8	251	12.4	209	16.0	329	11.9	185	7.5	112	14.6	236
Bread and other cereals	1.8	34	0.9	51	0.0	. . .	1.0	40	5.6	81	1.9	64
Pulses	20.4	91	17.7	125	19.8	105	19.8	128	24.3	170	20.4	125
Oil	19.5	46	20.4	84	23.6	87	28.7	79	27.1	143	23.7	90
Vegetables	10.6	83	15.9	121	17.0	127	16.8	116	16.8	270	15.4	148
Meat	2.7	75	1.8	52	5.7	103	3.0	228	4.7	172	3.5	131
Eggs	1.8	31	2.7	54	0.9	6	4.0	45	2.8	118	2.4	59
Milk	2.7	26	0.0	. . .	7.6	103	2.0	355	5.6	77	3.5	109
Fruits	1.8	79	2.7	55	2.8	56	5.9	48	5.6	57	3.7	56
Fish	2.7	83	2.7	48	5.7	177	5.0	115	9.4	366	5.0	211
Spices	10.6	103	15.0	111	14.2	145	11.9	231	16.8	271	13.7	175
Sugar and snacks	6.2	82	12.4	84	9.4	46	12.9	77	18.7	183	11.9	107
Drinks and other	6.2	86	7.1	123	9.4	162	4.0	168	11.2	238	7.6	164
Prepared foods	0.0	. . .	2.7	91	0.9	17	0.0	. . .	5.6	309	1.9	214
Total	55.8	774	57.5	1,029	56.6	1,031	51.5	1,128	50.5	1,336	54.4	1,048
Number of households	113		113		106		101		107		540	

Source: IFPRI-FMRSP, Household Survey 1998.

percent), chickens (6.2 percent), and trees (2.3 percent) than in the period before the floods.

The patterns of disposal across categories of severity of flood exposure were quite different (Table 6.8). Households not exposed to flooding tended to consume a larger share of their assets, mostly cereals and chickens. Households exposed to flooding tended to sell a larger proportion of their assets. For example, 7.3 percent of the households exposed moderately to the floods sold cattle, compared with 3.2 percent of the households not exposed to the floods. It is also the case that households exposed moderately and severely to the floods were more

Table 6.6 Meal eating and skipping, by severity of flood exposure (for the three days preceding the survey)

		Flood exposure			
	Not exposed	Moderate	Severe	Very severe	All
Average number of meals eaten	8.7	8.5	8.5	8.6	8.6
Average number of meals skipped	0.3	0.5	0.5	0.4	0.4
Incidence of meal skipping (%)	17.3	19.4	23.0	19.8	20.0
Number of people	970	755	1,073	798	3,596

Source: IFPRI-FMRSP, Household Survey 1998.

Note: This table excludes children under 2 years old, a large number of whom were breastfeeding, and people who were absent from the household in any of the previous three days.

Table 6.7 Households disposing of assets before the floods, during the floods, and after the floods, by asset type (percent)

	December 1997–June 1998		July 1998–October 1998		November 1998	
Type of asset	Consumed	Sold	Consumed	Sold	Consumed	Sold
House	0.00	0.26	0.00	0.13	0.00	0.00
Large trees	0.00	0.40	0.00	2.25	0.13	0.40
Cereals	25.63	3.04	24.17	0.26	22.19	0.66
Cattle	0.13	2.64	0.00	2.51	0.40	1.85
Goats/sheep	0.00	0.66	0.26	1.85	0.00	1.32
Chickens	9.11	3.96	7.27	6.21	7.40	7.00
Ducks	0.40	0.92	0.79	1.85	1.06	1.59
Fishing equipment	0.00	0.00	0.00	0.13	0.00	0.13
Motorcycle	0.00	0.13	0.00	1.19	0.00	0.26
Transport vehicle	0.00	0.13	0.00	0.00	0.00	0.00
Cheap household items	0.53	0.13	0.00	0.26	0.00	0.26
Radio/watch	0.00	0.26	0.00	0.00	0.00	0.00
Jewelry	0.00	0.00	0.00	0.26	0.00	0.00
Total	21.66	10.57	31.57	16.78	30.52	13.34
Number of households	757	757	757	757	757	757

Source: IFPRI-FMRSP, Household Survey 1998.

likely to sell assets than were those exposed very severely to the floods (see the sales of chickens and large trees for example). These results are probably determined by the fact that households exposed more severely to the floods lost more assets, and they therefore had fewer assets to consume (especially chickens) and maybe to sell. In fact, whereas 3.0 percent of households exposed moderately to flooding sold trees, only 0.6 percent of those severely exposed did so.

Looking at the distribution of flood-exposed households consuming and selling assets by expenditure quintile (Table 6.9), it emerges that, whereas more of the richer households sold cattle (7.9 percent and 5.6 percent in the fourth and the fifth quintiles, respectively, compared with 3.5 percent in the bottom quintile), more of the poorer households sold large trees and chickens. This means not only that poorer households had fewer assets to sell, but also that they had to sell what they had to raise some cash to maintain their level of current expenditure. In conclusion, however, it does not appear that a very large number of people sold many of their productive assets and valuable assets.

Determinants of Households' Coping Strategy

Table 6.10 summarizes some of the coping strategies employed by the households. It shows that the percentage of households in debt was very large. A total of 60.6 percent were in debt for a value equal to 143.6 percent of monthly expenditure. This percentage increases even more for the households in the bottom quintile, which have, on average, a debt of 222.3 percent. Purchases of food on credit were linked to borrowing. Only 29.5 percent of non-flood-exposed households purchased food on credit, whereas some 56.6 percent of flood-exposed households in the bottom three quintiles resorted to purchasing food on credit in the month preceding the survey (October 1998). The value of those expenses on credit were also sizable, especially for poor households (purchases of food on credit accounted for 39.1 percent of total monthly household expenditure for households in the bottom quintile).

Government transfers were also important in terms of the number of people receiving them but not in terms of the average amount received, which was equivalent to

Table 6.8 Percentage of households disposing of assets after July 1998, and average value, by type of assets and severity of flood exposure

	Flood exposure									
	Not exposed		Moderate		Severe		Very severe		All	
Type of asset	Percent of house-holds	Value (Tk)	Percent of house-holds	Value (Tk)	Percent of house-holds	Value (Tk)	Percent of house-holds	Value (Tk)	Percent of house-holds	Value (Tk)
Consumed										
Productive assets										
Cattle	0.5	1,600	0.0	. . .	0.5	1,600	0.6	6,250	0.4	3,150
Chickens	21.7	251	10.9	169	6.8	188	0.6	65	10.6	219
Ducks	1.8	84	1.8	96	1.5	95	0.6	48	1.5	87
Domestic assets										
Cereals	41.0	4,024	30.3	3,817	15.9	4,294	16.1	3,352	26.3	3,925
Liquid assets										
Large trees	0.0	. . .	0.6	3,267	0.0	. . .	0.0	. . .	0.1	3,267
Total consumed	45.2	3,794	32.7	3,656	18.8	3,941	17.3	3,340	29.1	3,727
Sold										
Productive assets										
Cattle	3.2	2,100	7.3	3,213	3.9	3,550	3.6	6,217	4.4	3,605
Goats/sheep	3.2	1,171	4.9	401	2.9	967	1.8	367	3.2	763
Chickens	9.2	187	13.3	192	17.4	291	11.3	272	12.8	244
Ducks	1.4	90	3.6	116	5.8	340	3.0	591	3.4	308
Fishing equipment	0.0	. . .	0.6	600	0.5	500	0.0	. . .	0.3	550
Domestic assets										
Cereals	1.8	1,463	1.2	1,750	0.5	3,500	0.0	. . .	0.9	1,836
Cheap household items	0.0	. . .	0.6	1,300	0.0	. . .	1.8	290	0.5	543
Housing										
House	0.0	. . .	0.6	5,000	0.0	. . .	0.0	. . .	0.1	5,000
Liquid assets										
Large trees	2.3	260	3.0	636	4.4	4,759	0.6	1,500	2.6	2,441
Jewelry	0.0	. . .	0.6	700	0.5	1,000	0.0	. . .	0.3	850
Consumer durables										
Motorcycle	2.3	6,875	1.8	13,000	1.0	14,125	0.0	. . .	1.3	10,163
Total sold	18.9	932	31.5	1,282	26.1	1,859	17.3	1,878	23.3	1,476
Number of households	217		165		207		168		757	

Source: IFPRI-FMRSP, Household Survey 1998.

only 2.0 percent of total household monthly expenditures, especially if compared with the size of their debts. From a first observation it appears that government transfers were targeted more towards the poor than towards flood-exposed households. In fact, 66.4 percent of the households in the bottom quintile received transfers, compared with 32.7 percent in the top quintile; and 52.6 percent of the flood-exposed households received transfers, compared with 33.6 percent of non-flood-exposed households (Table 6.10). A more detailed analysis of the distribution of government transfers will follow in Chapter 7.

The last of the coping strategies reported here is the selling of assets. Exposed households and non-exposed households sold assets in the same proportion (between 20 and 22 percent). As we saw before, it was not the selling of the assets that characterized the households exposed to the floods, but the types of assets sold. In general, the value of the assets sold was around 50 percent of the

Table 6.9 Percentage of flood-exposed households disposing of assets after July 1998 and average value, by total expenditure quintile

	Quintile 1		Quintile 2		Quintile 3		Quintile 4		Quintile 5		All	
Type of asset	Percent of households	Value (Tk)	Percent of households	Value (Tk)	Percent of households	Value (Tk)	Percent of households	Value (Tk)	Percent of households	Value (Tk)	Percent of households	Value (Tk)
Consumed												
Productive assets												
Cattle	0.0	. . .	1.8	3,925	0.0	. . .	0.0	. . .	0.0	. . .	0.4	3,925
Goats/ sheep	0.9	500	0.9	7,000	0.0	. . .	0.0		0.0		0.4	3,750
Chickens	2.7	56	5.3	151	7.5	194	5.9	183	9.3	201	6.1	174
Ducks	1.8	48	0.9	96	0.9	48	3.0	127	0.0	. . .	1.3	89
Liquid assets												
Large trees	0.0	. . .	0.0	. . .	0.0	. . .	1.0	3,267	0.0	. . .	0.2	3,267
Domestic assets												
Cereals	18.6	3,315	15.9	4,026	20.8	4,049	21.8	3,653	25.2	4,130	20.4	3,846
Total consumed	20.4	3,060	21.0	4,206	23.0	3,942	25.7	3,273	27.1	3,914	22.6	3,672
Sold												
Housing assets												
House	0.0	. . .	0.0	. . .	0.0	. . .	1.0	5,000	0.0	. . .	0.2	5,000
Productive assets												
Cattle	3.5	3,550	4.4	5,600	2.8	2,500	7.9	4,013	5.6	3,743	4.8	4,010
Goats/ sheep	5.3	715	3.5	550	5.7	520	0.0	. . .	0.9	500	3.1	595
Chickens	16.8	200	21.2	209	13.2	214	13.9	341	5.6	551	14.3	258
Ducks	6.2	723	7.1	175	1.9	250	4.0	69	1.9	248	4.3	336
Fishing equipment	0.0	. . .	0.0	. . .	0.0	. . .	1.0	600	0.9	500	0.4	550
Liquid assets												
Large trees	4.4	810	1.8	1,125	1.9	2,050	2.0	1,790	3.7	8,383	2.8	3,168
Jewelry	0.9	700	0.0	. . .	0.0	. . .	1.0	1,000	0.0	. . .	0.4	850
Domestic assets												
Cereals	0.9	200	0.0	. . .	0.0	. . .	1.0	3,500	0.9	3,300	0.6	2,333
Cheap household items	0.0	. . .	0.9	290	0.9	1,300	0.0	. . .	1.9	290	0.7	543
Consumer durables												
Motorcycle	0.0	. . .	0.9	10,000	1.9	14,125	0.0	. . .	1.9	5,525	0.9	9,840
Total sold	30.1	950	29.2	1,305	18.9	1,074	26.7	1,716	19.6	3,733	25.0	1,641
Number of households	113		113		106		101		107		540	

Source: IFPRI-FMRSP, Household Survey 1998.

Table 6.10 Coping strategies, flood exposure, and poverty

	Flood exposed						Not exposed	All households
	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	All		
Monthly household expenditure (Tk)	1,979.6	2,848.9	3,725.4	4,234.6	7,720.6	4,063.6	3,843.5	4,000.5
Share of food expenditures (%)	72.8	72.0	70.8	68.2	62.2	67.4	68.4	67.7
Households in debt (%)	66.4	69.9	62.3	55.4	62.62	63.5	53.5	60.6
Share of monthly expenditure (%)	222.3	149.8	135.1	142.5	131.3	144.4	140.2	143.6
Households purchasing food on credit (%)	55.8	57.5	56.6	51.5	50.5	54.4	29.5	47.3
Share of monthly expenditure (%)	39.1	36.1	27.7	26.6	17.3	25.8	20.0	25.0
Households receiving government transfers (%)	66.4	54.9	60.4	47.5	32.7	52.6	33.6	47.2
Share of monthly transfer on expenditure (%)	4.3	2.4	2.8	1.9	0.8	2.0	2.1	2.0
Households selling assets (%)	26.5	23.9	17.9	24.8	15.9	21.9	20.3	21.4
Share of monthly expenditure (%)	51.9	39.0	54.4	48.0	75.3	51.9	44.2	49.9
Number of households	113	113	106	101	107	540	217	757

Source: IFPRI-FMRSP, Household Survey 1998.

value of monthly expenditure, which is not negligible but is much smaller than the value of debt.

Though there are multiple coping strategies, which are simultaneously determined, here we present the results of reduced-form logit models for one coping strategy at a time, with only exogenous variables on the right-hand side. This model is similar to those used in the other sections of the report. The models look at the probability of borrowing, purchasing food on credit, skipping meals, and disposing of assets.

The results of the models (Table 6.11) confirm that borrowing, and especially borrowing for food, was one of the coping strategies most employed by the households exposed to flooding. There is a positive and significant correlation between borrowing and flood exposure in the model with village flood exposure variables and also in the household flood exposure random effects model, but not in the fixed effects model. This means that the common situation with respect to the floods was more important than the differences among the people in determining the probability of borrowing.

On the other hand, the probability of purchasing food on credit is strongly related to the level of flood exposure in all the models (Table 6.11). In the village flood exposure model, households severely and very severely exposed to the floods are more than four times as likely to purchase food on credit than non-flood-exposed households. This relationship, even if not so strong, remains in the fixed effects model, which means that, at the level of the same village, the difference in flood exposure makes a difference in the decision to purchase food on credit.

The results on the determination of skipping meals do not show any correlation with flood exposure. As we saw in the descriptive section, the data on eating behavior were collected only after the floods. Moreover, the difference between flood-exposed and non-flood-exposed households was relative only to the distribution of the incidence of meal skipping among household members of different gender.

Table 6.11 Determinants of individual household coping strategies: Summary of regression results

	Village flood exposure		Household flood exposure Random effects		Household flood exposure Fixed effects	
	Odds ratio	*z*-statistic	Odds ratio	*z*-statistic	Odds ratio	*z*-statistic
Borrowing						
Moderate	1.52	1.89*	1.69	1.95*	1.23	0.61
Severe	1.75	2.63*	1.15	0.53	0.66	–1.13
Very severe	1.28	0.95	1.64	1.78*	1.15	0.35
Prob > χ^2	0.00	0.05	0.07			
Number of observations	753		753		645	
Purchase of food on credit						
Moderate	1.67	2.24*	2.21	2.84*	1.80	1.64
Severe	2.92	4.93*	3.53	4.60*	2.23	2.07*
Very severe	4.58	5.60*	2.70	3.43*	1.41	0.84
Prob > χ^2	0.00	0.00	0.10			
Number of observations	753		753		645	
Skipping meals						
Moderate	0.47	–1.12	0.87	–0.24	0.70	–0.29
Severe	1.22	0.38	0.98	–0.03	0.38	–0.89
Very severe	1.17	0.27	0.86	–0.27	0.46	–0.68
Prob > χ^2	0.00	0.08	0.01			
Number of observations	720		753		211	
Selling assets						
Moderate	0.94	–0.25	2.29	2.71*	1.79	1.54
Severe	0.99	–0.04	1.40	1.09	1.25	0.55
Very severe	0.48	–2.25*	0.96	–0.12	1.10	0.21
Prob > χ^2	0.09	0.21	0.14			
Number of observations	753		753		531	
Consuming assets						
Moderate	0.69	–1.36	0.85	–0.36	1.07	0.12
Severe	0.24	–5.00*	0.48	–1.49	1.02	0.02
Very severe	0.21	–4.05*	0.59	–1.00	1.36	0.42
Prob > χ^2	0.00	0.00	0.00			
Number of observations	753		753		384	

Sources: IFPRI-FMRSP, Household Survey 1998 and authors' calculations.

* denotes that the coefficient is statistically significant at 10% level or less.

Finally, the regression results provide further evidence that flood-exposed households did not consume and sell assets to a greater extent than did non-flood-exposed households. Consumption of assets is in fact negatively correlated with severity of flood exposure in the village flood exposure model, perhaps in part because only households that did not lose or sell their assets had the option to consume them.

Rather than selling assets, flood-exposed households adopted borrowing or credit purchases of food as their predominant coping strategy—a strategy that, however, left most of them in debt for an amount equal on average to almost 150 percent of their current monthly expenditures. The choice of borrowing rather than sales of assets by flood-exposed households suggests that households that had not lost their assets in the flood had adequate access to credit. This enabled them to cope with the floods with only limited sales of liquid assets and to avoid selling more valuable assets.

In some ways, these results are a little different from the hypothesis at the beginning of the chapter in which we did not expect that borrowing would play such a big and determinant role. We also found that, although all the coping strategies mentioned

in the rapid appraisals done in the field during and after the floods were used by some of the households, some were employed more often (borrowing) than others (selling assets) and more by poor flood-exposed households than by others.

Summary

In this chapter we have carried out an analysis of the coping strategies used by rural people in Bangladesh to deal with the losses sustained in the aftermath of the floods. We found that the coping strategies listed in the rapid appraisal reflected the pattern expected of households affected by a large covariate shock such as the floods. These strategies included selling assets, borrowing, and reducing food consumption.

The analysis of the household survey showed that the predominant form of coping strategy used by flood-exposed households was to borrow money or to purchase food on credit. Loans were mostly contracted from informal sources to cover consumption shortfalls and also to get resources for productive reasons. This of course had become more necessary, since the farming and producing households had to use their savings and assets to cope with the hardships of the floods. This means that, even though households were able to use borrowing as a way to smooth their consumption, they were left in debt and at further risk of not recovering from another individual or aggregate shock.

Selling assets, in contrast, was not found to be a major form of coping strategy. Some people did sell some livestock to raise some cash, but this was probably also a way to reduce the expense of caring for them.

CHAPTER 7

Impacts of Government Food Relief Operations

The government of Bangladesh, nongovernmental organizations (NGOs), and private individuals implemented numerous programs in order to meet the immediate needs of flood-affected households. These efforts varied over time. They began with immediate relief efforts involving the provision of shelter, clothing, food, and clean water while the floodwaters still covered much of the country in August and September 1998. Subsequently, relief efforts gradually gave way to flood rehabilitation programs, involving not only food transfers and income support, but rehabilitation of infrastructure, credit for future agricultural production, and other development efforts. This chapter focuses mainly on food relief efforts during the first five months of the flood and post-flood periods (August through December 1998). We explore the effectiveness of the targeting of government programs and alternatives to direct food transfers.

Targeting of Government Food Relief and Other Transfers

Two major channels dominated government food relief efforts following the floods: Gratuitous Relief (GR), designed to provide emergency relief to disaster victims, and Vulnerable Group Feeding (VGF), aimed at assisting households over a longer period (ultimately, from September 1998 through April 1999).[73] Immediate short-term relief through GR was targeted by location. In contrast, the VGF program covered all areas of the country (both flooded and non-flood-affected areas), and was administratively targeted to poor households through selection by local committees (del Ninno and Roy 1999a). The size of these programs was limited, however, both by available wheat stocks (up to early November when government commercial imports and food aid arrivals added to government stocks) and by the financial cost of the programs (covered to a large extent by food aid).

Major flood relief efforts began in August 1998 through the provision of 20,400 metric tons of rice through Gratuitous Relief (GR) in flood-affected *thanas* and an additional 30,800 metric tons of rice in September. In addition, the Vulnerable Group Feeding (VGF) program began on a large scale in August with an initial distribution of 1.3 million cards entitling the

[73] Food for Work (FFW) programs began on a large scale only in December 1998, following the *aman* rice harvest when soils were dry enough to permit manual earthworks to build roads and culverts.

Table 7.1 Percentage of households receiving transfers and average value of transfers, by severity of flood exposure

	Flood exposure				
	Not exposed	Moderate	Severe	Very severe	All
Total government transfers					
Percent	33.6	44.2	53.1	60.1	47.2
Value (Tk)	317.7	322.4	318.0	350.2	327.9
Gratuitous Relief (GR)					
Percent	9.7	23.6	31.4	35.7	24.4
Value (Tk)	125.4	125.6	164.2	198.3	162.7
Vulnerable Group Feeding (VGF)					
Percent	19.4	22.4	24.2	21.4	21.8
Value (Tk)	295.4	332.7	290.7	332.0	310.3
Other government transfers					
Percent	7.4	9.1	12.6	17.3	11.4
Value (Tk)	509.3	344.9	327.1	354.3	373.3
NGO transfers					
Percent	3.2	7.3	12.1	22.6	10.8
Value (Tk)	273.1	468.6	315.0	328.0	339.9
Private transfers					
Percent	8.8	10.9	9.7	7.1	9.1
Value (Tk)	5,122.2	5,937.8	6,083.2	3,495.8	5,330.7
Total transfers					
Percent	41.5	49.1	62.8	70.2	55.4
Value (Tk)	1,362.0	1,683.5	1,269.5	771.5	1,229.2
Number of households	217	165	207	168	757

Note: The value of transfers is over the four months from July 15 to November 15, 1998, for receiving households.

holder to 8 kilograms of rice per month. During August and September, a total of 27,500 metric tons of rice were distributed through this program. At 8 kilograms/card, an estimated 1.35 and 2.13 million households received VGF rations in August and September, respectively. Almost no wheat was distributed through relief channels in the early months of the floods. At the urging of the World Food Programme (WFP), the government of Bangladesh expanded the VGF program to 4 million cards with an allotment of 16 kilograms of grain per card—half rice and half wheat in October, and all wheat thereafter (del Ninno and Dorosh 2001).

Table 7.1 provides evidence of the extent to which these programs were well targeted with respect to flood exposure. In the seven *thanas* of the household survey sample of the International Food Policy Research Institute Food Management and Research Support Project, 47.2 percent of all households received some form of government transfers. The GR program was better targeted towards flood-exposed households than was the VGF program. Only 9.7 percent of GR recipients, compared with 19.4 percent of VGF recipients, were not directly exposed to the floods. On the other hand, among the very severely exposed households, 35.7 percent received GR transfers and 21.4 pecent received VGF transfers. Neither program achieved large coverage though: 69.6 percent of flood-affected households did not receive GR and 77.2 percent did not receive VGF. In contrast to the VGF program, transfers from NGOs were particularly well targeted to households exposed to the floods: 22.6 percent of very severely flood-exposed households received transfers from NGOs, compared with only 3.2 percent of non-flood-exposed households.

Even though the VGF program was not very well targeted toward flood-exposed

Table 7.2 Percentage of flood-exposed households receiving transfers and average value of transfers, by expenditure quintile

	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	All
Total government transfers						
Percent	66.4	54.9	60.4	47.5	32.7	52.6
Value (Tk)	343.0	273.9	412.5	328.9	256.9	330.6
Gratuitous Relief (GR)						
Percent	38.1	35.4	34.0	23.8	19.6	30.4
Value (Tk)	174.1	148.6	165.8	184.5	173.7	167.5
Vulnerable Group Feeding (VGF)						
Percent	35.4	24.8	27.4	17.8	7.5	22.8
Value (Tk)	338.4	255.6	357.8	331.0	221.0	315.4
Other government transfers						
Percent	10.6	12.4	17.0	13.9	11.2	13.0
Value (Tk)	391.9	277.4	419.1	303.4	297.9	342.2
NGO transfers						
Percent	10.6	17.7	13.2	11.9	15.9	13.9
Value (Tk)	297.7	327.8	300.1	297.7	474.2	346.2
Private transfers						
Percent	4.4	7.1	11.3	9.9	14.0	9.3
Value (Tk)	940.0	4277.6	3016.3	4701.2	9891.0	5409.9
Total transfers						
Percent	68.1	63.7	67.0	56.4	48.6	60.9
Value (Tk)	441.5	826.8	940.8	1170.1	3181.1	1192.8
Number of households	113	113	106	101	107	540

Note: The value of transfers is over the four months from July 15 to November 15, 1998, for receiving households.

households, it was better targeted to the poor than was GR (Table 7.2). In total, 66.4 percent of flood-exposed households in the first quintile received some type of government transfer; 35.4 percent of these households received VGF grain (mainly wheat) and 38.1 percent received GR grain (mainly rice). VGF was fairly well targeted by expenditure; nonetheless, 17.8 percent and 7.5 percent of flood-exposed households in quintiles 4 and 5, respectively, were participants. In comparison, 19.6 percent of flood-exposed households in the top expenditure quintile received GR transfers. The size of these transfers was relatively small, though. The average value of grain received by participating households between July and November 1998 was only Tk 310 for VGF and Tk 163 for GR.

Private transfers were not highly correlated with flood exposure, but it is notable that the poorest 20 percent of households received only about one-fifth as much in transfers as the average household in the sample. Therefore it does not appear that government transfers crowded out private transfers, as they appear to have done in other countries.[74]

Logit models of the determinants of participation in GR and VGF programs provide further evidence of the degree to which these programs were targeted towards the poor and flood-affected households (Table 7.3). The dummy variables for village-level flood exposure, and particularly the dummy variables for severe and very severe flood exposure, are highly significant in explaining receipt of GR transfers. Households in flood-exposed villages were four to six times more likely to receive GR transfers than households in non-flood-exposed villages. In the fixed effects model, the odds ratios relative to the variable for households with very severe

[74] See World Bank (2000) and Cox and Jimenez (1998).

Table 7.3 Determinants of participation in Gratuitous Relief and Vulnerable Group Feeding programs: Regression results

	Village flood exposure logit				Household flood exposure fixed effects logit			
	Gratuitous Relief		Vulnerable group feeding		Gratuitous relief		Vulnerable group feeding	
Independent variables	Odds ratio	*z*-statistic	Odds ratio	*z*-statistic	Odds ratio	*z*-statistic	Odds ratio	*z*-statistic
Female-headed household	0.92	–0.15	2.25	1.57	0.44	–1.19	2.32	1.45
Age of household head	1.03	2.11*	0.99	–0.90	1.02	1.21	0.99	–0.85
Percent males 0–4 years	1.02	1.52	0.97	–1.55	1.00	0.26	0.97	–1.39
Percent males 5–14 years	1.03	2.25*	0.95	–3.16*	1.02	1.43	0.95	–3.13*
Percent males 15–19 years	0.99	–0.35	0.98	–0.99	0.99	–0.56	0.98	–1.17
Percent males 20–34 years	1.01	0.73	0.95	–2.93*	1.00	0.12	0.95	–2.71*
Percent males 35–54 years	1.05	3.30*	0.98	–1.60	1.03	2.00*	0.98	–1.24
Percent females 0–4 years	0.98	–1.15	1.01	0.50	0.99	–0.64	1.01	0.76
Percent females 5–14years	0.98	–1.30	1.02	1.77*	0.98	–1.22	1.03	1.85*
Percent females 15–19 years	0.99	–0.51	1.04	2.12*	1.00	0.17	1.04	1.83*
Percent females 20–34 years	0.99	–0.69	1.02	1.25	0.99	–0.60	1.01	0.84
Percent females 35–54 years	0.99	–0.72	1.01	0.57	1.00	–0.34	1.01	0.55
Household size	0.69	–2.12*	1.53	2.16*	0.78	–1.22	1.67	2.32*
Number of males: Any primary education	1.15	1.13	1.35	2.02*	1.13	0.82	1.37	1.90*
Number of males: Any secondary education	0.69	–1.57	1.24	0.90	0.61	–1.73*	1.20	0.68
Number of females: No education	1.83	2.00*	0.45	–2.40*	1.66	1.42	0.39	–2.51*
Number of females: Any primary education	1.40	1.08	0.42	–2.53*	1.08	0.23	0.34	–2.77*
Number of females: Any secondary education	1.13	0.28	0.25	–2.64*	0.78	–0.51	0.24	–2.51*
Pre-flood value of land (Tk thousand)	1.01	1.33	1.00	–0.43	1.01	1.46	0.99	–0.92
Productive asset value (Tk thousand)	0.82	–1.53	0.76	–1.26	0.73	–1.84*	0.73	–1.31
Liquid asset value (Tk thousand)	0.99	–0.25	0.86	–1.05	1.03	0.26	0.87	–0.95
Housing asset value (Tk thousand)	0.88	–2.83*	0.89	–1.75*	0.85	–2.74*	0.86	–2.10*
Domestic asset value (Tk thousand)	2.14	2.01*	0.37	–1.79*	1.41	0.57	0.53	–1.05
Other assets value (Tk thousand)	3.42	1.28	0.02	–1.03	4.15	0.99	0.01	–1.14
Number of dependent workers	0.81	–0.95	0.95	–0.20	0.76	–1.02	0.93	–0.27
Number of day laborers	1.01	0.05	1.19	0.83	1.21	0.87	1.15	0.59
Persons engaged in business and cottage industry	0.84	–0.74	0.89	–0.41	0.74	–1.03	0.83	–0.59
Persons in own farm	1.11	0.59	1.14	0.61	1.07	0.31	1.11	0.43
Moderately flood exposed	4.61	4.85*	0.38	–2.93*	1.48	0.88	0.67	–1.04
Severely flood exposed	6.64	6.16*	0.61	–1.73*	2.16	1.62	0.76	–0.75
Very severely flood exposed	5.48	4.90*	0.64	–1.26	3.09	2.18*	0.71	–0.88
Number of observations		753		753		544		442
Number of villages						83		66
Wald χ^2						103.83		57.21
Prob $\chi^2 > 0$						0.00		0.00
Lr χ^2		129.54		73.73				
Prob $\chi^2 > 0$		0.00		0.00				
Pseudo R^2		.15		.11				

* denotes that the coefficient is statistically significant at the 10% level or less.

flood exposure is 3.09. This means that, in flood-exposed villages, very severely exposed households were three times more likely to receive GR transfers than other households in the same village.

For VGF targeting, flood exposure does not appear to have been a criterion for targeting households. In fact, the coefficients for the village-level flood exposure variables and the household flood exposure variables in the fixed effects specification are not statistically significant. Instead, the odds ratio relative to household size is larger than 1 and significant and all the coefficients relative to asset ownership are less than 1. The coefficient on the dummy variable for female household head is also larger than 1, though not statistically very significant.

Table 7.4 Determinants of per capita calorie consumption due to village flood exposure and amount received in GR transfers: Regression results

	Ordinary least squares model		2-stage least squares model	
Independent variables	**Coefficient**	***t*-statistic**	**Coefficient**	***t*-statistic**
Female-headed household	–614.82	–3.55*	–576.58	–2.82*
Age of household head	–3.47	–0.68	–5.77	–0.96
Percent males 0–4 years	–7.31	–0.54	–7.49	–0.53
Percent males 5–14 years	–3.85	–0.59	–7.40	–0.99
Percent males 15–19 years	–4.59	–0.72	–6.01	–0.82
Percent males 20–34 years	0.44	0.07	–0.53	–0.08
Percent males 35–54 years	–0.79	–0.16	–11.64	–1.49
Percent females 0–4 years	–13.47	–3.06*	–9.04	–1.72*
Percent females 5–14years	–10.80	–2.65*	–6.96	–1.47
Percent females15–19 years	–3.35	–0.69	–2.37	–0.40
Percent females 20–34 years	–4.25	–0.78	–4.63	–0.71
Percent females 35–54 years	5.21	1.40	12.9	12.54*
Household size	–100.64	–0.93	–56.16	–0.48
Number of males: Any primary education	36.40	0.82	63.17	1.23
Number of males: Any secondary education	41.66	0.79	77.97	1.14
Number of females: No education	22.47	0.14	–39.46	–0.22
Number of females: Any primary education	40.55	0.25	16.55	0.09
Number of females: Any secondary education	68.62	0.41	51.03	0.28
Pre-flood value of assets (Tk thousand)	30.39	4.61*	33.55	4.37*
Moderately flood-exposed	–18.13	–0.16	–175.41	–1.26
Severely flood-exposed	–198.83	–2.07*	–516.20	–2.92*
Very severely flood-exposed	–130.62	–1.03	–405.20	–1.83*
Value of GR transfer received[a]	–0.74	–2.49*	4.80	1.88*
Constant	3,209.07	8.02*	3,138.80	6.73*
Number of observations		753		734
R^2		.18		

[a] Value of GR transfer received has been instrumented using: Female-headed household; age of household head; proportion males: 0–4 years, 5–14 years, 15–19 years, 20–34 years, 35–54 years; proportion females: 0–4 years, 5–14years, 15–19 years, 20–34 years, 35–54 years; household size; number of males: any primary education, any secondary education; number of females: no education, any primary education, any secondary education; pre-flood value of assets (Tk thousand); moderately flood-exposed; severely flood-exposed; very severely flood-exposed; number of household members engaged in dependent work, day work, own farm, or own business; number of buildings; house with a tin roof; availability of electricity; ownership of cattle.
* denotes that the coefficient is statistically significant at the 10% level or less.

Impact of Government Food Relief

We have established that government transfers were small but that they played a very important role in helping households, especially in the period of the floods. Did they have any impact on other measures of outcome? To answer this question we looked at the impact of GR transfers on per capita calorie consumption. The results of the model are reported in Table 7.4.

In the first regression, we run a modified model of the determinants of per capita calorie consumption as a function of household characteristics, pre-flood assets, and village flood exposure. In the second model we added to these explanatory variables the value of GR transfers received. As expected, the value of the coefficient was negatively correlated with the amount of calorie consumption. This means that, as we have noticed in the previous analysis, households that were poorer and consumed fewer calories were more likely to receive GR transfers.

In order to account for this apparent problem, we use an instrumental variable model (for example, Ravallion and Wodon 2000; Rivers and Vuong 1988). The results of this model (Table 7.4) show that the GR transfers did indeed have a small, but positive, impact

on the level of per capita calorie consumption.[75] This confirms the hypothesis that the program was well targeted and had a positive impact on the well-being of poor households.

Cash Transfers for Short-Term Flood Relief

Direct distribution of food and relief supplies was vitally important during the floods and in the immediate post-flood period. By late September 1998, the floodwaters had receded in most of the country and transport links had been reestablished nearly everywhere. Yet many people still faced critical problems of insufficient food. Unfortunately, as discussed above, because of delayed food aid arrivals and limited government stocks, the availability of foodgrains in government warehouses was a constraint on the expansion of VGF and other programs.

Given that, by late September, poor households in most of the country had access to well-supplied markets, their food consumption was constrained by lack of purchasing power rather than by food availability per se. The months of September and October are normally slack periods of labor demand in rural areas, and the floods made it even more difficult for the rural poor to find employment. Increasing purchasing power to affected households was a feasible alternative to direct food distribution and increased food aid in the short run because, in the post-flood, pre-harvest period (from mid-September to end-November), food supply was no longer a constraint at the local or national levels. As discussed above, private sector imports kept rice prices at import parity and markets supplied with rice.

Moreover, much of the 1997/98 *boro* and 1998/99 *aman* harvests remained in private stocks. The 1998 *boro* harvest was about 8.0 million metric tons, and the flood-damaged *aus* rice crop was 1.6 million metric tons (down by 300,000 metric tons from the target of 1.9 million metric tons). Thus, about 9.6 million metric tons of rice had been harvested in Bangladesh from May through September. In addition, the private sector had imported 0.5 million metric tons from India between July and mid-September (and continued to import more than 200,000 metric tons per month from September 1998 through March 1999). Since average national rice consumption is about 1.4 million metric tons per month, the 10.1 million metric tons of total rice supply from the previous *boro* and *aus* harvests, combined with imports through mid-September (adjusted for losses), could have covered consumption for at least six months, that is, until December 1998. Moreover the December *aman* harvest was expected to add another 7.6 million metric tons of rice, and several thousand metric tons of food aid wheat were scheduled to arrive by December as well.

Thus, following the floods of 1998, except in the immediate post-flood period, household food security in Bangladesh was constrained not by food availability in markets, but by household access to food. However, government distribution of food faced two other constraints as well: the availability of public foodgrain stocks and the finances for relief and rehabilitation efforts.

Food aid eventually eased these two constraints on public distribution. By providing food, it eased the government stock situation. And, because the food aid was given as a grant, it placed no added burden on the government treasury. Yet, additional use of cash payments could have enabled the government and donors to provide even more immediate help to flood victims. Had donors provided cash to supplement direct food distribution, the total value of the VGF program could have been substantially increased without endangering government foodgrain stocks.

There were, in effect, three distinct periods following the floods, each with its own

[75] We also tested the significance of the impact of the predicted value of the GR transfers by adding the predicted value of the residual of the first-stage regression, which we found to be significantly different from zero.

constraints on household food security and policy options. Immediately after the floods (mid-July to mid-September in most regions), household food security was constrained both by the availability of foodgrains in local markets as well as by purchasing power. With transport networks and markets disrupted, the immediate food needs of flood victims could be met only by direct food distribution. Later, when foodgrain availability in markets was no longer a constraint but government foodgrain stocks had not yet been replenished through government commercial imports or food aid (late September to mid-November), relief efforts were constrained by government stocks and the financial cost of aid.[76] Finally, once government stocks had again been built up (mid-November), relief efforts were constrained only by the financial and administrative costs of the programs.

One argument often advanced against the use of cash payments is that leakages are likely to be larger than in the case of food. This need not occur if transparency is maintained at both the local and national levels. In order to minimize losses through cash programs, one option could be to give the NGOs and other local institutions a major role in seeing that the money allocated for relief in a particular locality actually reaches poor flood-affected households. Nonetheless, even if leakages in cash distribution are somewhat higher, these costs must be weighed against the benefits of increasing the value of aid to the poor before the arrival of large food aid shipments.

Implications for Food Aid and Targeting Distribution

Food security at the household level depends on the availability of food in markets as well as on access to food.[77] Liberalization of private sector imports of rice and wheat in the early 1990s and ensuing government policies supporting trade in 1998 enabled private imports to stabilize market prices and supplies. Government direct distribution programs, though small compared with private imports, nonetheless increased poor households' access to food. Given the tight resource constraints on the size of distribution programs, effective targeting is crucial. Immediate relief efforts were well targeted to flood-affected households, as were transfers from NGOs. VGF, a medium-term program, covered non-flood-affected regions and, even in flood-affected *thanas,* was not well targeted to households directly exposed to the floods. Nonetheless, according to survey data from seven flood-affected *thanas,* the program was relatively well targeted to poor households, with households in the three lowest expenditure quintiles receiving an estimated 75 percent of the foodgrains distributed through this program.

More broadly, the Bangladesh experience with the 1998 flood illustrates the dual role of food aid in increasing availability and providing resources for enhancing the access of food insecure households. In a liberalized trade regime where private imports respond to price signals, food aid's contribution to the total availability of food may be minimal. Nonetheless, foreign assistance, in kind or in cash, can provide resources for subsidized, targeted distribution to food-insecure households—assistance not otherwise possible under tight government budget constraints.

Summary

In this chapter we have shown that food aid and government transfers were effective in providing some relief to poor households exposed to the floods. These transfers were small in size and too limited in coverage, however, to have a major impact on the recovery of households from the floods. Nonetheless, Gratuitous Relief transfers were well targeted towards poor flood-exposed

[76] In addition, the difficulties of administering a large-scale, targeted emergency program slowed deliveries initially.

[77] As discussed in Chapter 5, intrahousehold distribution is an important aspect of food security (utilization) for individual household members.

households and appear to have had an impact on the level of per capita calorie consumption. Moreover, these government transfers did not crowd out private transfers, which were received by only a small number of people who were not necessarily poor or exposed to the floods.

We have also shown that the government of Bangladesh and the donor community played an important role in procuring the resources necessary for the use and expansion of already existing programs. The Bangladesh experience, along with other cases cited in the *World Development Report 2000* (World Bank 2000), suggests that it is much easier to expand programs that are already in place at the time of a shock than to design specific new programs. Unfortunately, in Bangladesh the expansion of relief programs in the immediate aftermath of the floods was constrained by the levels of government stocks. Given that private markets were well supplied by rice and wheat from domestic sources as well as by a steady flow of private sector imports, cash transfer programs could have been used instead of grain, especially in the GR program, without leading to increases in foodgrain prices. Such cash transfers could have been extremely effective, because many households contracted large debts in order to buy food.

CHAPTER 8

Conclusions and Lessons from the 1998 Floods

Summary of Findings

This report has described the extent of the damage caused by the 1998 Bangladesh floods to production, transport infrastructure, markets, private assets, and the lives and the well-being of people. Yet, despite a 2.2 million ton shortfall of *aman* and *aus* rice because of the floods, there was no food crisis in Bangladesh. No one died from lack of food, market price increases were small (particularly in comparison with the crisis of 1974), and there was no large migration of people to urban areas in search of food. Households did suffer because of the floods, as documented in this report and elsewhere, but a combination of private market foodgrain imports, food aid, public foodgrain distribution and relief, and household coping strategies (including borrowing and shifts in food expenditures) kept the floods from becoming a truly major disaster.

The availability of foodgrains in the market in Bangladesh after the floods was maintained mainly through an increase in imports of rice from India, and to a lesser extent through wheat from food aid and government commercial imports. The government of Bangladesh, which had launched an appeal for relief efforts in August 1998, was able to increase the distribution of foodgrains in the country by only a small amount in the period immediately after the floods. However, careful management of public foodgrain stocks may have contributed to market stability, by reducing the likelihood of short-term and localized shortages. Because of this combination of private sector imports, public foodgrain distribution, and stock policy, the market prices of rice and wheat in late 1998 were only slightly higher than those in the early part of the year (following a poor rice harvest in December 1997). Moreover, with domestic foodgrain markets functioning well, regional price variations were similar to those in other years.

Nevertheless, even though foodgrains were available at a reasonable price, households still did not have access to enough food, because the losses they suffered during the floods reduced their level of income and wealth. Losses of assets in terms of damage to homes, trees, and small livestock were very large. Income losses were caused by loss of agricultural production and lack of jobs, especially during the floods, in both the agricultural and the non-agricultural sectors because of the slowing down of the economy. Employment opportunities

picked up again after the floods to a level similar to that of the previous year, but it was not enough make up for the income losses suffered.

The deterioration in the economic situation and the health environment had a major negative impact on food consumption, food security, and health outcomes. For many households, food consumption was reduced and food insecurity increased, but there was no evidence of an increase in the bias in the food allocated to women. A substantial increase in illness, especially diarrhea and respiratory illnesses, was noticed during the floods and in the immediate post-flood period. The floods also led to increases in both wasting and stunting among preschool children.

In response to reduced employment opportunities, losses of assets, and higher food prices, households adjusted by reducing consumption and by borrowing. Flood-exposed poor households adjusted their food expenditures by reducing consumption of vegetables and other goods in short supply, and ultimately by consuming fewer calories. Most of all, they borrowed heavily from friends, neighbors, and local moneylenders to finance food and other expenditures, suggesting that additional cash transfers and credit programs could have enhanced households' ability to cope with the floods and helped them to recover in the medium term. Nonetheless, through these coping strategies and government transfers, private households managed to get through a period of low incomes and higher food prices.

Programs by the government, donors, and nongovernmental organizations (NGOs) brought emergency relief in the initial period of flooding and increased the access of poor, flood-exposed households to food through direct distribution of food and other resources. This report shows that direct transfers by the government and NGOs during the floods were well targeted to flood-exposed households. Government transfers in the period after the floods were better targeted towards poor households than towards areas more affected by the floods.

Policy Implications

Both short-term and long-term policies played major roles in preventing the 1998 floods from resulting in a major food security disaster in Bangladesh. Public sector investments in agricultural research and extension in the 1980s and 1990s, together with mainly private sector investments in small-scale irrigation, led to substantial increases in wheat and *boro* rice production, making the country less at risk from flooding by increasing total foodgrain production in the country, reducing the length of time between major crops from 12 months to only about 6 months, and leading to a shift away from highly flood-susceptible deepwater *aman* cultivation in the monsoon season to *boro* cultivation in the dry season. Continued investment in research and extension could further increase production efficiency and reduce the vulnerability of the food sector to floods.

In addition, long-term public investments in infrastructure (roads, bridges, electricity, and telephones) contributed to efficient marketing systems that enabled the private sector grain trade to supply markets throughout the country following the floods. Government policies also encouraged private sector participation in the grain trade. In particular, the liberalization of rice and wheat imports in the early 1990s enabled private sector imports to quickly supply domestic markets and stabilize prices at their import parity levels following the floods. Short-term policies such as the removal of the import tariff on rice in early 1998 and instructions to expedite port clearance of private sector foodgrain imports also provided clear signals to the private sector of government support for this trade. Moreover, these private sector imports proved to be a far less costly alternative for maintaining foodgrain availability than distribution of government commercial imports or public stocks, the mechanisms by which the gov-

ernment handled the production shortfalls from the 1988 floods, 10 years earlier.

Donors responded to the flood situation with major increases in food aid. These eventually permitted a major expansion of targeted foodgrain distribution through the Vulnerable Group Feeding (VGF) and Food for Work (FFW) programs. However, almost inevitable delays and uncertainties in food aid arrivals resulted in only a small net increase in public distribution beyond pre-flood plans until December 1998, in part because existing government stocks of wheat were insufficient for a large expansion in distribution. (Rice stocks were kept in reserve for possible use in stabilizing markets later.) A policy of holding more stocks might not have been a better option, though, given substantial costs in procurement of grain, handling, and eventual distribution. With foodgrain supplies and prices stabilized by private sector imports, targeted cash transfers to supplement direct food transfers could have been used to increase household access to food (and other basic needs) without increasing market prices of foodgrains.

Nonetheless, programs already in place and a rapid expansion of the VGF program to more than 4 million households enabled public foodgrain distribution following the floods to be well targeted to the poor. Poor women and children, many of whom were chronically malnourished, were effectively targeted through the VGF program. More targeted credit programs would have been useful, however, given that poor households borrowed heavily in the informal private market during the floods and NGO credit programs were limited in scope. To avoid delays and to minimize leakages, these rural credit programs for disaster relief should be designed and put in place before disasters occur. Maintaining a structure of social programs that can be scaled up in the event of a disaster is more important that maintaining a large stock of food.

To reduce even further the impact of another natural disaster like the floods of 1998, it is necessary to improve the scope and the quality of the interventions so as to provide food, water, and shelter at the time of the disaster and in its immediate aftermath. Relief should be targeted at both the village and individual levels. This report has shown that interventions at the village level, such as providing shelter, improving sanitary conditions, and creating economic opportunities, were effective in alleviating the adverse impact of the floods. We have also presented evidence that targeting to individual poor, flood-exposed households can have a positive impact on the well-being of individual children. Finally, government policies to foster economic growth in rural areas and to provide income-earning alternatives to poor households can both help to reduce poverty as well as increase the capacity of households to withstand shocks resulting from natural disasters.

Conclusions

The combined efforts of the government of Bangladesh, donors, NGOs, and flood-affected households themselves, together with private trade operating in well-functioning markets, were in general extremely successful in mitigating the effects of the 1998 floods at the household level and avoiding a major food crisis. Thus, the Bangladesh example illustrates the importance of coordinated actions at the sectoral and household levels, by both public and private sectors, in maintaining the availability of and access to food to ensure food security following major supply disruptions. Private trade alone might have provided sufficient availability of food, though this would in itself not have solved the problem of access to food for millions of households. Public sector actions enhanced access to food by flood-exposed households, though these interventions were too small to have a major direct effect on overall availability and market prices. Ultimately, food security in Bangladesh was largely maintained through an appropriate mix of public interventions, private market trade flows,

and an extensive system of private borrowing. Continued investments in agricultural research, extension, roads, electricity, and other rural infrastructure, along with policies promoting efficient markets and programs to provide targeted transfers and credit to poor households, could help further to enhance the food security of the poor.

APPENDIX A

Distribution and Plots of Category Variables Used for the Flood Exposure Index

People in rural Bangladesh in the period of the floods appear to have been exposed in different ways. We calculated an index of household exposure to the flood that used a combination of indicators (Table A.1 and Figure A.1).

Table A.1 Frequency distribution of category variables used for the flood exposure index

	Category	Frequency	Percentage
Depth of water in homestead (feet)			
0	0	246	32.50
0.1–1.0	1	110	14.53
1.1–2.0	2	142	18.76
2.1–3.0	3	175	23.12
3.1–4.0	4	53	7.00
4.1+	5	31	4.10
Depth of water in house (feet)			
0	0	246	32.50
0.1–1.0	1	80	10.57
1.1–2.0	2	147	19.42
2.1–3.0	3	173	22.85
3.1–4.0	4	43	5.68
4.1–5.0	5	39	5.15
5.1+	6	29	3.83
Number of days of water in the home			
0	0	247	32.63
0–7.0	1	74	9.78
7.1–15.0	2	89	11.76
15.1–30.0	3	130	17.17
30.1–60.0	4	133	17.57
60.1+	5	84	11.10

Figure A.1 Frequency distribution of households by various variables of flood exposure

Water in homestead	Frequency	
0	246	**********
1	110	**********
2	142	**********
3	175	**********
4	53	**********
5	31	*******
Total	757	

Water in home	Frequency	
0	246	**********
1	80	**********
2	147	**********
3	173	**********
4	43	**********
5	39	********
6	29	******
Total	757	

Days of water	Frequency	
0	247	**********
1	74	**********
2	89	**********
3	130	**********
4	133	**********
5	84	**********
Total	757	

Index	Frequency	
0	217	**********
1	15	****
2	11	***
3	18	****
4	30	*******
5	39	**********
6	52	**********
7	69	**********
8	72	**********
9	66	**********
10	58	**********
11	36	**********
12	28	*******
13	26	******
14	8	**
15	11	***
16	1	
Total	757	

APPENDIX B

Supplementary Tables

Table B.1 Monthly average price of high-yielding varieties of coarse rice, 1998 (Tk per kilogram)

Division	Average price	Standard deviation	Maximum	Minimum	Maximum/ minimum
Barisal division					
June	11.87	0.44	11.75	9.75	1.21
August	12.92	0.41	13.67	12.50	1.09
October	14.20	0.54	14.78	13.33	1.11
Chittagong division					
June	11.83	0.42	12.42	10.88	1.14
August	13.36	0.71	14.18	12.15	1.17
October	14.27	0.85	15.33	13.00	1.18
Dhaka division					
June	11.25	0.70	12.53	9.76	1.28
August	13.45	0.68	15.10	12.56	1.20
October	14.33	0.62	15.35	13.06	1.18
Khulna division					
June	11.18	0.57	11.75	9.75	1.21
August	13.02	0.39	13.67	12.50	1.09
October	14.09	0.56	14.78	13.33	1.11
Rajshahi division					
June	10.83	0.63	12.08	9.82	1.23
August	12.97	0.56	13.85	12.23	1.13
October	14.01	0.60	14.92	13.10	1.14
Sylhet division					
June	11.53	0.86	12.70	10.79	1.18
August	13.94	0.25	14.25	13.64	1.05
October	14.67	0.83	15.75	13.77	1.14
All Bangladesh					
June	11.31	0.69	12.70	9.75	1.30
August	13.23	0.62	15.10	12.15	1.24
October	14.21	0.65	15.75	13.00	1.21

Source: DAM data and authors' calculations.

Table B.2 Total value of assets owned, by severity of flood exposure

		Flood exposure			
Asset category	**Not exposed**	**Moderate**	**Severe**	**Very severe**	**All**
Productive	6,787	7,604	6,409	4,926	6,448
Domestic	2,066	1,659	1,508	1,573	1,716
Housing	25,475	28,076	22,661	21,132	24,310
Liquid	8,049	12,113	7,679	12,413	9,661
Consumer durables	2,619	3,375	1,434	1,911	2,393
Others	2,130	1,512	1,148	1,351	1,525
Total	40,767	45,476	35,839	35,840	39,352

Source: IFPRI-FMRSP, Household Survey 1998.

Table B.3 Number of households that suffered any asset losses, by flood exposure

		Flood exposure			
Asset category	**Not exposed**	**Moderate**	**Severe**	**Very severe**	**All**
Productive	21	39	56	48	164
Domestic	—	10	32	37	79
Housing	17	82	133	125	357
Liquid	15	35	50	40	140
Consumer durables	1	. . .	. . .	1	2
Others	. . .	. . .	. . .	6	6
Total	41	100	143	131	415

Source: IFPRI-FMRSP, Household Survey 1998.

Table B.4 Total value of assets lost for households that suffered any losses, by flood exposure

		Flood exposure			
Asset category	**Not exposed**	**Moderate**	**Severe**	**Very severe**	**All**
Productive	413	1,300	942	1,000	979
Domestic	. . .	311	177	207	208
Housing	2,509	5,541	5,649	6,221	5,675
Liquid	4,692	3,094	2,906	8,428	4,722
Consumer durables	500	. . .	. . .	1,000	750
Others	. . .	. . .	. . .	2,182	2,182
Total	2,990	6,164	6,679	9,042	6,936

Source: IFPRI-FMRSP, Household Survey 1998.

Table B.5 Total value of assets owned for households that suffered any losses, by flood exposure

		Flood exposure			
Asset category	**Not exposed**	**Moderate**	**Severe**	**Very severe**	**All**
Productive	5,439	13,408	8,034	6,437	8,512
Domestic	. . .	2,213	2,148	2,257	2,207
Housing	13,368	28,735	22,198	22,235	23,292
Liquid	12,669	15,432	11,577	26,353	16,880
Consumer durables	6,000	. . .	. . .	5,000	5,500
Others	. . .	. . .	. . .	2,578	2,578
Total	39,551	49,872	38,055	38,244	41,110

Source: IFPRI-FMRSP, Household Survey 1998.

References

Accra Study Team. 1998. *Promoting urban food and nutrition security for the vulnerable in the Greater Accra metropolitan area.* Final Report of the Accra Urban Food and Nutrition Study to the World Health Organization. Legon, Ghana: Noguchi Memorial Institute for Medical Research and Washington, D.C.: International Food Policy Research Institute.

ACC/SCN (United Nations Administrative Committee on Coordination/Subcommittee on Nutrition). 2000. *Fourth report on the world nutrition situation.* Geneva: ACC/SCN in collaboration with the International Food Policy Research Institute.

Ahmed, Faruk, Moududur Rahman Khan, Md Omar Faruque, Shirin Taj, Tasmin Hyderi, and Alan A. Jackson. 1998. Serum retinol is influenced by social factors and antioxidant nutrients among adolescent girls in urban Bangladesh. *International Journal of Food Sciences and Nutrition* 49 (1): 39–45.

Ahmed, R. 2000. Liberalization of agricultural input markets in Bangladesh. In O*ut of the shadow of famine: Evolving food markets and food policy in Bangladesh,* ed. R. Ahmed, S. Haggblade, and T. E. Chowdhury. Baltimore, Md., U.S.A.: Johns Hopkins University Press for the International Food Policy Research Institute.

Ahmed, R., S. Haggblade, and T. E. Chowdhury, eds. 2000. O*ut of the shadow of famine: Evolving food markets and food policy in Bangladesh.* Baltimore, Md., U.S.A.: Johns Hopkins University Press for the International Food Policy Research Institute.

Alamgir, M. 1980. *Famine in South Asia: Political economy of mass starvation.* Cambridge, Mass.: Oelgeschlager, Gunn and Hain.

Ali, Mir M., M. M. Hogue, Rezaur Rahman, and Salim Rashid. 1998. *Bangladesh floods: Views from home and abroad, 1998.* Dhaka: University Press.

Bangladesh Water Development Board. 1998. *Annual flood report.* Flood Forecasting and Warning Centre.

Banu, Shireen, and Iftekbar Hussain. 1998. Report on the visit to six flood-affected districts. Dhaka, Bangladesh.

Baulch, Bob, Jayanta Das, W. M. H. Jaim, Naser Farid, and Sajjad Zohir. 1998. *The spatial integration and pricing efficiency of the private sector grain trade in Bangladesh: Phase I and II report.* Bangladesh Institute of Development Studies, Bangladesh Agricultural University, and University of Sussex.

BBS (Bangladesh Bureau of Statistics). 1997. *Child nutrition survey of Bangladesh 1995-96.* Dhaka: Bangladesh Bureau of Statistics, Statistics Division, Ministry of Planning.

———. 1998. *Household expenditure survey 1995–96.* Dhaka: Bangladesh Bureau of Statistics, Statistics Division, Ministry of Planning.

———. 1998. *Statistical yearbook, 1998.* Government of Bangladesh.

BHC (British High Commission). 1998. *Rapid flood appraisal report.* Flood field report undertaken in Mymensingh, Jamalpur, Siranjganj, Pabna, Bogra, Manikganj and Dhaka districts, September 6–9, 1998, by the First Secretary British High Commission.

Bouis, H. 1993. Food consumption surveys: How random are measurement errors? In *Data needs for food policy in developing countries,* ed. J. von Braun and D. Puetz. Washington, D.C.: International Food Policy Research Institute.

Bouis, H., and M. J. G. Novenario-Reese. 1997. *The determinants of demand for micronutrients: An analysis of rural households in Bangladesh.* Food Consumption and Nutrition Division Discussion Paper No. 32. Washington D.C.: International Food Policy Research Institute.

Bouis, H., B. de la Briere, L. Guitierrez, K. Hallman, N. Hassan, O. Hels, W. Quabili, A. Quisumbing, S. Thilsted, Z. H. Zihad, and S. Zohir. 1998a. *Commercial vegetable and polyculture fish production in Bangladesh: Their impacts on income, household resource allocation, and nutrition.* Washington, D.C.: International Food Policy Research Institute.

Bouis, H., M. Palabrica-Costello, O. Solon, D. Westbrook, and A. B. Limbo. 1998b. *Gender inequality and investments in adolescents in the rural Philippines.* Research Report 108. Washington, D.C.: International Food Policy Research Institute.

Chowdhury, N., and S. Haggblade. 2000. Evolving rice and wheat markets. In O*ut of the shadow of famine: Evolving food markets and food policy in Bangladesh,* ed. R. Ahmed, S. Haggblade, and T. E. Chowdhury. Baltimore, Md., U.S.A.: Johns Hopkins University Press for the International Food Policy Research Institute.

CMIE (Centre for Monitoring Indian Economy). 1998–2000. *Monthly review of the Indian economy,* various issues. Mumbai, India.

Cox, D., and E. Jimenez. 1998. Risk-sharing and private transfers: What about urban households. *Economic Development and Cultural Change* 46 (3): 621–639.

Das, J., S. Zohir, and B. Baulch. 1997. Spatial integration of foodgrain markets in Bangladesh: Pricing analysis. Dhaka: Bangladesh Institute of Development Studies. Manuscript.

del Ninno, C., and P. A. Dorosh. 2001. Averting a food crisis: Private imports and public targeted distribution in Bangladesh after the 1998 flood. *Agricultural Economics* 25: 1–10.

del Ninno, C., and D. K. Roy. 1999a. Impact of the 1998 flood on labor markets and food security and effectiveness of relief operations in Bangladesh. Food Management and Research Support Project Working Paper 8, Dhaka.

———. 1999b. The 1998 flood and household food security: Evidence from rural Bangladesh. Food Management and Research Support Project Working Paper 9, Dhaka.

Democracy Watch. 1998. *Flood and post-flood situation in the rural areas of Bangladesh.* Report by Mr. Abul Hossain Ahamed Bhuiyan, advisor to Democracy Watch, Bangladesh Open University.

Department of Agricultural Marketing (DAM), Ministry of Agriculture, Government of Bangladesh. Unpublished data.

Directorate General of Food, Ministry of Food, MIS data. Unpublished.

Dorosh, P. A. 1999a. Foodgrain markets and policy in the aftermath of the 1998 flood. Food Management and Research Support Project Working Paper 7, Dhaka.

———. 1999b. *The determination of rice prices in Bangladesh: Supply shocks, trade liberalization and cross-border trade.* Food Management and Research Support Project Working Paper 2, Dhaka.

———. 2000. Foodgrain production and imports: Toward self-sufficiency in rice? In O*ut of the shadow of famine: Evolving food markets and food policy in Bangladesh,* ed. R. Ahmed, S. Haggblade, and T. E. Chowdhury. Baltimore, Md., U.S.A.: Johns Hopkins University Press for the International Food Policy Research Institute.

———. 2001. Trade liberalization and national food security: Rice trade between Bangladesh and India. *World Development* 29: 4.

Dreze, J., and A. Sen. 1989. *Hunger and public action.* Oxford: Clarendon Press.

———. 1991. *The political economy of hunger,* 3 volumes. Oxford: Clarendon Press.

FAO (Food and Agriculture Organization of the United Nations). *Food balance sheets,* various issues.

Foster, A. 1995. Prices, credit markets and child growth in low-income rural areas. *Economic Journal* 105: 551–570.

FPMU (Food Planning and Monitoring Unit). 1999. *Database on food situation Bangladesh.* Dhaka: Ministry of Food, Government of Bangladesh.

Frankenberger, T. 1992. A indicators and data collection methods for assessing household food security. In *Household food security: Concepts, indicators, measurements. A technical review,* ed. S. Maxwell and T. Frankenverger. New York and Rome: UNICEF and IFAD.

Goletti, F. 1993. The effects of supply shocks on market integration: An application to rice markets in Bangladesh. International Food Policy Research Institute, Washington, D.C. Mimeo.

———. 1994. *The changing public role in a rice economy approaching self-sufficiency: The case of Bangladesh.* Research Report 98. Washington, D.C.: International Food Policy Research Institute.

Greene, W. H. 1997. *Econometric analysis,* 3d ed. Upper Saddle River, N.J.: Prentice-Hall.

Haddad, L., E. Kennedy, and J. Sullivan. 1994. Choices of indicators for food security and nutrition monitoring. *Food Policy* 19 (3): 329–343.

Harriss, B. 1995. The intrafamily distribution of hunger in South Asia. In *The political economy of hunger,* ed. J. Dreze, A. Sen, and A. Hussain. Oxford: Oxford University Press.

Hausman, J. A. 1978. Specification tests in econometrics. *Econometrica* 46: 1251–1271.

Hena, H., and A. Kabir. 1998. *Assessment of food needs for people affected by flood in Bangladesh.* Flood field report undertaken in Shariatpur, Madaripur, Faridpur, Gopalganj, and Rajbari, August 31–September 4, 1998. World Food Programme.

HKI (Helen Keller International). 1998a. *Impact of the 1998 floods on rural households in Bangladesh: A special report from the nutrition surveillance project.* Dhaka.

———. 1998b. *Post flood alert: Malnutrition on the rise in Bangladesh after the worst flood of the century: Potential long-lasting consequences.* Dhaka.

Hossain, M. 1990. Natural calamities, instability in production and food policy in Bangladesh. *The Bangladesh Development Studies* 18 (4).

Hossain, M., L. Bose, and A. Chowdhury. 2001. Changes in agriculture and economy in the flood-prone environment in Bangladesh, 1988 to 2000: Insights from a repeat survey of 16 villages. Paper presented at the

Workshop on Floodprone Rice Systems, January 9–11, 2001, organized by the Bangladesh Rice Research Institute and the International Rice Research Institute. Manuscript.

Hossain, S., and M. Moazzem. 1998. *Flood and health.* Posting on the Bangladesh flood 1998 internet site (http://bangladeshflood98.org/health/health1.html) reporting results of study undertaken by Save the Children (UK), Dhaka, Bangladesh.

Hossain, S., and M. Moazzem, and Muhammad Shuaib. 1998. *Rapid nutrition assessment during flood 1998: Coping mechanisms and community perception of suitable rehabilitation.* Dhaka: Save the Children Fund UK.

Irrigation Support Project for Asia and the Near East. 1993. Flood response and guidelines on planning flood proofing. Bangladesh Flood Action Plan FAP 14/ FAP 23. Photocopy.

Islam, Md. Khairul. 1998. *Combating health problems in flood 1998: Observations and learning.* Dhaka: PLAN International.

Johnson, U., and D. Toole. 1991. Household food security and nutrition: A conceptual analysis. New York: UNICEF. Mimeo.

Judge, G. G., W. E. Griffiths, R. C. Hill, H. Lutkepohl, and T. C. Lee. 1985. *The theory and practice of econometrics,* 2nd ed. New York: John Wiley.

Khan, A. Z., and M. Obaidullah. 1999. Bangladesh floods 1998 and food security. Paper prepared for the Conference on Natural Disasters and Policy Response in Asia: Implications for Food Security. Harvard University, Cambridge, Mass., April 30–May 1, 1999 (draft). Manuscript.

Khan, S. H., and E. Haque. 1998. *Assessment of food needs for people affected by flood 1998 in Bangladesh.* Flood field report undertaken in Serajgonj, Bogra, and Gaibandha districts, August 31–September 3, 1998. World Food Programme.

Lifschultz, L. 1979. *Bangladesh: The unfinished revolution.* London: Zed Press.

Maxwell, S., and Frankenberger, T. 1992. *Household food security: Concepts, indicators, measurements. A technical review.* New York and Rome: UNICEF and IFAD.

Maxwell, D., C. Ahiadeke, C. Levin, M. Armar-Klemesu, S. Zakariah, and G. Mary Lamptey. 1999. Alternative food-security indicators: Revisiting the frequency and severity of "coping strategies." *Food Policy* 24: 411–429.

MHFW (Ministry of Health and Family Welfare). 1995. *Bangladesh country paper on nutrition.* Government of the People's Republic of Bangladesh in collaboration with the Bangladesh National Nutrition Council. Dhaka.

Mitra, S. N., A. Al-Sabir, A. R. Cross, and K. Jamil. 1997. *Bangladesh demographic and health survey, 1996–1997.* Dhaka and Calverton, Md.: National Institute of Population Research and Training (NIPORT), Mitra and Associates, and Macro International, Inc.

Murduch, J. 1999. Between the state and the market: Can informal insurance patch the safety net? *World Bank Research Observer* 14 (2): 187–207.

Murshid, K. A. S. 1999. *Liberalization and foodgrain imports: The evolution and conduct of the border trade with India.* Food Management and Research Support Project Working Paper 11, Dhaka.

NPAN (Bangladesh National Plan of Action for Nutrition). 1997. Prepared by the Ministry of Health and Family Welfare, Government of the People's Republic of Bangladesh in collaboration with the Bangladesh National Nutrition Council. Dhaka: Bangladesh National Nutrition Council.

Osmani, S. R. 1991. The food problems of Bangladesh. In *The political economy of hunger*, volume 3, ed. J. Dreze and A. Sen. Oxford: Clarendon Press.

———. 1995. The food problems of Bangladesh. *The political economy of hunger.* Dhaka: University Press.

Pramanik, M. A. H.. 1994. Natural disasters. In *Environment and development in Bangladesh,* ed. A. A. Rahman, R. Haider, S. Huq, and E. G. Jansen. Vol. 1. Dhaka: University Press.

Rahman, H., and S. Choudhury. 1998. *Report on flood situation and impact of flood.* Flood field report undertaken in Pabna, Rajshahi, Nawabgan, and Naogaon districts, August 31–Sepember 3, 1998. World Food Programme.

Ravallion, M. 1985. The performance of rice markets in Bangladesh during the 1974 famine. *Economic Journal* 95.

———. 1990. *Markets and famines.* Dhaka: University Press.

———. 1997. Famines and economics. *Journal of Economic Literature* 35 (3) (September): 1205–1242.

Ravallion, M., and Q. Wodon. 2000. Does child labor displace schooling? Evidence on behavioral responses to an enrollment subsidy. *Economic Journal* 110: 158–175.

Rivers, D., and Q. H. Vuong. 1988. Limited information estimators and exogeneity tests for simultaneous Probit models. *Journal of Econometrics* 39 (3): 347–366.

Sen, A. 1981. *Poverty and famines.* Oxford: Clarendon Press.

Shahabuddin, Q., and S. Zohir. 1995. Medium- and long-term projections of foodgrain demand, supply and trade balance in Bangladesh. *The Bangladesh Development Studies* 23 (3–4).

Shahjahan, M. 1998. Flood disaster management in deltaic plain integrated with rural development. In *Bangladesh floods: Views from home and abroad,* ed. M. M. Ali, M. M. Hoque, R. Rahman, and S. Rashid. Dhaka: University Press.

Sobhan, R. 1979. Politics of food and famine in Bangladesh. *Economics and Political Weekly,* December 1, 24-28.

UNICEF (United Nations Children's Fund). 1990. *Strategy for improved nutrition of children and women in developing countries.* New York.

———. 1998. Tackling malnutrition in Bangladesh. Panel 14 in *State of the World's Children 1998.* New York.

UNICEF-ADB (United Nations Children's Fund and Asian Development Bank). 1997. *Reducing child malnutrition in selected Asian countries: Strategies for Bangladesh.* Study undertaken by the Institute of Nutrition and Food Science and Department of Economics, University of Dhaka, and Dhaka Urban Community Health Program at the invitation of the United Nations Children's Fund and the Asian Development Bank.

USDA (United States Department of Agriculture). *Rice and wheat outlook,* various issues.

von Braun, J., T. Teklu, and P. Webb. 1999. *Famine in Africa: Causes, responses, and prevention*. Baltimore, Md., U.S.A.: Johns Hopkins University Press for the International Food Policy Research Institute.

World Bank. 2000. *World development report 2000.* Washington, D.C.

World Food Programme (WFP). 1998. *Field report on flood assessment.* Flood field report undertaken in Mymensingh, Netrakona, Kishoreganj, and Tangail Districts, August 31–September 4, 1998.

Zaman, H. 1999. Assessing the impact of microcredit on poverty and vulnerability in Bangladesh. Policy Research Working Paper 2145. Washington, D.C.: World Bank.

Zohir, S. 1995. Problems and prospects of crop diversification in Bangladesh. *Bangladesh Development Studies* 21 (September): 73–90.