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THE IMPACT OF RICE PRICES ON THE NUTRITIONAL STATUS OF CHILDREN

in Rural Bangladesh

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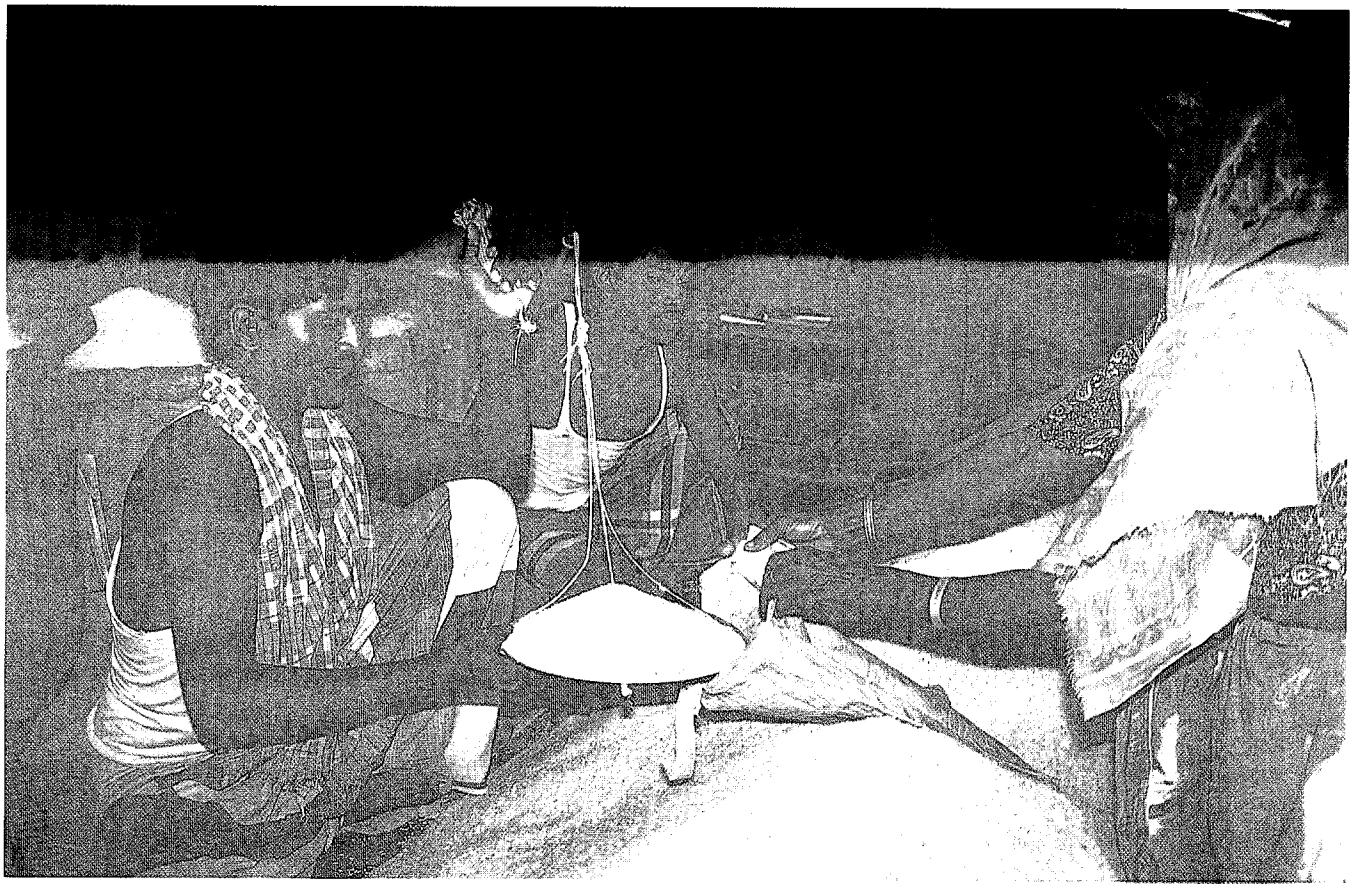

Nutritional Surveillance Project (NSP)

HELEN KELLER INTERNATIONAL

BANGLADESH

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THE IMPACT OF RICE PRICES ON THE NUTRITIONAL STATUS OF CHILDREN

Executive Summary

This report explores rice price fluctuations and their impact on household food expenditure, consumption and nutritional status of children in rural Bangladesh. In normal years, rice prices fall in June during the *Boro* harvest, then increase gradually through to November, and fall sharply again in December during the *Aman* harvest. The patterns in 1992 and 1994 (*Boro* to *Aman* season) were very different. In 1992 rice prices continued to fall from the *Boro* harvest June through to October. In 1994 rice prices rose sharply in June and continued to rise through to the *Aman* season. The variation in prices during these time periods provides a unique opportunity to analyze the impact of rice price fluctuations on consumption and nutrition of the rural population. Household socioeconomic indicators, individual child health and nutrition indicators, as well as community level price indicators were used to assess the impact.

Rice plays a vital role in household consumption, expenditure and production. It accounts for 40-60% of household expenditure, provides more than 70% of caloric intake and is a source of income in the following ways: (1) Wage income from agriculture labor (2) Income from *Aman, Borro, Aus* rice production at three different times of the year. Rice is therefore a powerful determinant of real income, consumption and nutrition of the rural poor.

A study was conducted based on data from the Nutrition Surveillance Project to evaluate the impact of rice prices and to understand the behavior of different households during rice price fluctuations. The specific research methodology consisted of four components. First, three distinct time periods reflecting different levels of rice prices were identified: (1)"Control Period"- reflects expected seasonal levels, (2)"Consumption Holiday Period"- which reflects lowest ever prices recorded by NSP, and (3) "High Rice Period"- which reflects the highest ever rice prices recorded by the NSP. Secondly, households were disagregated by per capita food expenditure quintiles (used as a proxy for income) to segregate households with different socioeconomic characteristics and identify their response to different price levels measured by household consumption, expenditure and distress indicators. Thirdly, nutritional status of children (6-59 months) in the households was used as the final measure to evaluate the impact of rice price fluctuation. Lastly, descriptive and multivariate analyses were performed to assess the impact of rice price fluctuations.

Results from the study are: (1) Children in all quintiles showed relative improvement in nutritional status from the "Control Period" to the "Consumption Holiday Period". However, the magnitude of improvement in nutritional status varied by quintiles, with children in the fifth then fourth expenditure quintiles showing the greatest improvement in nutritional status measured by underweight followed by children in the second, first and third expenditure quintiles (2) Nutritional status of children in all quintiles deteriorated from the "Consumption Holiday Period" to "High Rice Price Period", with the magnitude of decline varying among quintiles. Children in second, fourth and fifth quintiles showed the highest nutritional deterioration.

Ownership of land plays a fundamental role in both low and high rice price periods. Children from households which have land, particularly medium and large land owners represented in the fourth and fifth expenditure quintiles benefited in the consumption holiday time period. During this relatively lower rice price period, these households were able to consume more of their own production as less of their own production was sold. The availability of rice from own production most likely increased grain consumption among the children of interest; the resulting benefit is evident in the dramatic improvement of nutritional status of children in these households.

Land also played an important role for children from households in the second expenditure quintile, which ranked third in terms of nutritional benefit from the consumption holiday period. These households are mostly landless and marginal households and in the "Consumption Holiday Period" with relatively lower

rice prices, they purchased more rice from the market and had also the opportunity to spend more on other foods. The increase in real income, due to the decline in rice prices, translates into increased food availability. Increased food availability, shown by increased per capita rice intake and food expenditure, coincides with improved nutritional status among children in these households.

From the "Consumption Holiday Period" to "High Rice Price Period", households in the fourth and fifth expenditure quintiles were hit by two events. First, with the relatively higher prices, the incentive to sell depleted reserves from own production and secondly, per capita paddy production declined for both quintiles, partly due to the high price of inputs (especially for the fourth quintile). The two events are reflected in the overall decline in per capita grain intake both in kg (weekly intake) and kcal (daily intake) for households in these two quintiles. This most likely results in the reduced food grain intake among children of interest in the households This reduction in food grain intake coincides with the dramatic deterioration in nutritional status among children in these households.

In the "High Rice Price Period" households in the second expenditure quintile consumed less rice and more wheat. Thus overall grain intake levels dropped. On the expenditure side, households reverted back to "Control Period" expenditure levels on grain, and expenditure on other foods dramatically declined. This overall reduction in grain intake levels and the reduction in other food expenditure by the households coincides with deterioration of nutritional status of children in these households.

The "Consumption Holiday" clearly had a very positive impact on nutritional status, constituting what was arguably the most successful nutrition intervention in Bangladesh's history. Clearly agricultural policies which can sustainably increase production of rice and sustainably reduce price will have a positive impact on children in rural Bangladesh.

Poor households, such as those in the first three quintiles, cannot afford enough food to eat. Their dependency on grain, particularly rice, makes them clearly vulnerable to market price fluctuations. This is shown in the average malnutrition rates. These households will continue to suffer from higher malnutrition unless their purchasing power increases. For these households, it is essential to invest in household production schemes such as homestead gardening, poultry and fish rearing which both increase household food availability directly and indirectly through improving their purchasing power. Further, during times of crisis, these households resort to purchasing wheat as an alternative to rice. Changing food habits slightly to increase the perceived desirability of wheat could have a sustained positive impact on nutritional status. A pilot activity should be undertaken to assess if a social marketing approach could improve the consumption of wheat and sustainably increase the proportion of wheat in the diet.

For households which are land owners, like those in the fourth and fifth expenditure quintiles, two issues emerge from this analysis. First, there is a real need for crop diversification on the production side in order to reduce the dependency of farmers on rice production. Further, these households will also benefit from household production schemes, in particular homestead gardening, which provides an alternative consumption source and reduces dependency on pure grain consumption.

Future Studies

This study provides a foundation for further in-depth analysis into the issues of grain consumption, market prices and nutritional status in Bangladesh.

Areas for future studies are: (1) rice prices and regional variation in nutritional status (2) using rice price as a direct indicator, and running a time series analysis to evaluate lagged impact of rice price fluctuations on nutritional status (3) analyzing the variation in impact of rice price fluctuation on households with more than one child 6-59 months old (4) variation in nutritional status by gender in relationship to fluctuation in rice prices and (5) analyzing the extent to which homestead vegetable production and/or involvement in NGO activities buffers the impact of rice price fluctuations.

1. Introduction

Food expenditure among low income rural families in Bangladesh accounts for more than 70% of household expenditure of which 40-60% accounts for spending on rice (1). Among food, rice provides more than 70% of household caloric intake and wheat 10% (1). In rural Bangladesh, wheat is considered to be an inferior commodity (1). Rice is therefore a powerful determinant of real income, consumption and nutrition of the rural poor.

Food price stabilization in Bangladesh has often meant the stabilization of rice prices. When rice prices change, the consumption of all food commodities change due partly to a substitution effect and partly to an income effect. Income effect leads to more consumption of all so-called normal commodities when real income rises. The substitution effect induces more consumption of those commodities whose relative price has declined (5) .

In normal years, rice prices fall in June during the *Boro* crop harvest, then rises gradually through November, and falls sharply in December during the *Aman* harvest. The pattern in the 1992 and 1994 *Boro* to *Aman* season was very different. In 1992, from the *Boro* harvest rice prices continued to fall till October 1993. This fall stabilized at a below seasonal price level from December 1992 to October 1993, before rising again to seasonal levels. Rice price movements from *Boro* to *Aman* season in 1994/1995 moved in the opposite direction. From the 1994 *Boro* harvest, rice prices continued to rise through the *Aman* harvest before falling again in June 1995. An agriculture calendar for Bangladesh is included in attachment 3. The steady increase was the highest price level ever recorded by the Nutritional Surveillance Project (NSP), which is discussed below. The variations in prices among these time periods provides a unique opportunity to analyze the impact of rice price fluctuations on consumption and nutrition of the rural population.

The NSP has been designed for disaster preparedness, monitoring of relief and nutrition trends and not specifically to assess impact of rice prices on nutritional status. However, over the years it has become clear that the system has broader usage. The following analyses are somewhat constrained by the nature of the data set, however, it is felt that even with these constraints much valuable information can be derived.

This report explores rice price fluctuations and their impact on household food expenditure, consumption and nutritional status of children in the rural setting from the NSP. Household socioeconomic indicators, individual child health and nutrition indicators, and community level price indicators will be used to assess the impact of rice price fluctuations.

The report is organized into eight sections. Following the introductory section, analytical methodology is discussed in section 2 and data used in the analysis is discussed in section 3. Graphical results showing the relationship between rice price movement and nutritional status of children using three indicators of nutritional status (weight-for-age, weight-for-height, and height-for-age) are presented in section 4. In section 5, results from the descriptive analysis using household distress, consumption, expenditure indicators, and child health and nutrition indicators stratified by food expenditure quintiles for the specified time period are presented. Further, a descriptive summary of the types of households represented in the different quintiles is also presented. The results of the multivariate analysis assessing the impact of rice price fluctuations on the nutritional status of children 6-59 months old controlled for child health, household socioeconomic and demographic indicators are presented in section 6. In section 7, policy issues emerging from the analysis are discussed and in Section 8, areas for future studies are presented.

The NSP, which began in October 1989, is a system of disaster preparedness, monitoring of relief and nutritional trends in Bangladesh which collects data on children's nutritional and health status, household socioeconomic and demographic indicators, grain prices, and other distress indicators. Community, household and individual indicators are collected every two months in sentinel sites. In rural areas, sentinel sites are sub-districts (*thanas* in Bangla) and in urban areas, they are slums. Data collection started in 1990 in 10 rural *thanas* and 4 urban slums. A list of all sentinel sites, and a map of current sites are in attachments 1 and 2. The rural sample is representative of rural *thanas*, the urban sample is taken from specific slums that are working areas of non governmental organizations (NGOs) and are neither representative of all urban slums nor of all urban areas. The methodology of the NSP has been presented in detail elsewhere (4). This report uses data from a total of 28 rural *thanas* collected during the data collection rounds from August 1991 to April 1995.

2. Analytical Methodology

The rice price element implies an increase or decrease in real purchasing power or income of rural households as rice expenditure is a significant portion of household total food expenditure. When rice prices decrease, the real purchasing power and therefore consumption opportunities of households can be expected to increase. A decline in rice prices can therefore be expected to increase household food expenditure, acquisition and consumption. Furthermore, since this increase in purchasing power occurs through a mechanism which does not increase time demands on care providers of children, it also may result in increased intake of food by the household members most likely to be calorie deficient - preschoolers - and thus improve nutritional status.

As rice is also a production item, for those households who grow their own food and are net sellers, market price fluctuations can induce conflicting behavior. For example, the increase in prices of produce induces an income effect in favor of more food purchasing. The substitution effect induces the opposite, because selling the produce rather than consuming it is more rewarding financially when prices are higher. This analysis will determine which effect dominates or how actually these households behave when prices change.

Children from two types of households, those who rely on wage income, and those households who sell and consume their own produce, will be the focus of this study. For households that depend on wages for their livelihood, variations in wage rates alter their nominal income, or money value. Similarly, variations in market prices of goods change the households real income, or how much they can buy in the market place with a given nominal income. Higher prices, for example, reduce real income. For this study, it is assumed that wage rates are relatively stable. In contrast, households that sell or consume their own produce benefit from higher prices of their products and lower prices of inputs.

For this study, three distinct time periods are identified for analysis purposes. Time period 1 (T1) - August 1991 to June 1992 - is considered "Normal" months when rice prices showed expected seasonal variations. Time period 2 (T2) - December 1992 to October 1993 - is identified as "Consumption Holiday" when rice prices dropped to the lowest levels ever recorded by NSP and maintained this level for 6 months (Figure 1). Time period 3 (T3) - June 1994 to April 1995 - is identified as "High Rice Price Period" during which rice prices increased to the highest levels ever recorded by the NSP. From time period 1-2, there was a 25% decline in rice prices, and between time period 2-3, there was a 33% increase in rice prices. The time periods identified as T1, T2 and T3 are therefore direct measures of relative rice price in the six rounds of data selected for each time period.

Sample households in this study are disagregated by per capita food expenditure to capture any existing income interaction effects and identify different groups of households in relation to their income and the varying impact of rice price fluctuations. In this study, per capita food expenditure is utilized as a proxy for income for two reasons. First, based on the permanent income hypothesis (6), expenditure is a better indicator of income and hence an important determinant of food acquisition and consumption patterns. Second, data on expenditures is generally more reliable than income data. Total household expenditure would have been an appropriate proxy for income. However, NSP does not gather information on total household expenditure.

The primary focus of analysis are the children who are 6-59 months. Child food intake levels are not gathered by the NSP. Intake level analysis is primarily based on overall grain intake separated by rice and wheat at the household level. From the household level, per capita grain intake level is calculated based on family size. Therefore, variation in intake levels according to sex and age of household members are not taken into account.

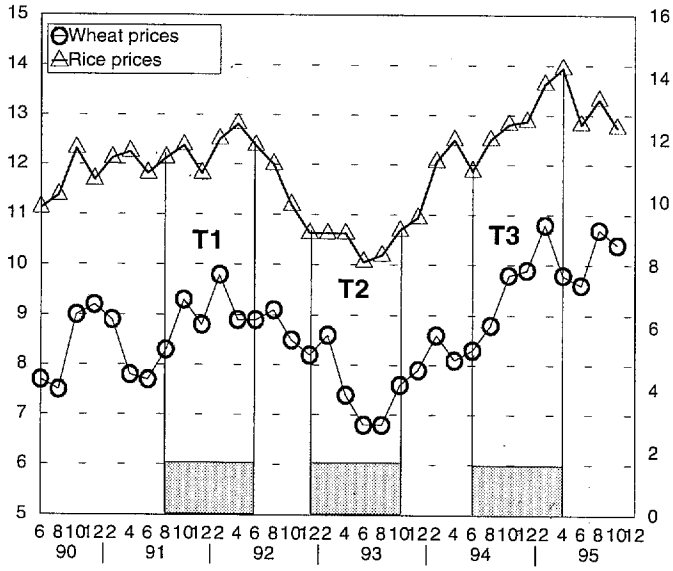

Figure 1. Rice and wheat prices in rural areas, June 1990 - December 1995

To evaluate nutritional status, wasting (weight-for-height), stunting (height-for-age) and underweight (weight-for-age) are used as indicators. Weight-for-height reflects more a child's current nutritional status, because weight can fluctuate due to acute disease, while height cannot. Children whose weight is too low for height are too thin and are called wasted. Height-for-age reflects a child's past or chronic nutritional status, as it is influenced by long-term food shortage, and chronic or frequently recurring diseases (8, 3). Children who are too short for their ages are called stunted. For this study, weight-for-age is used as the primary indicator of nutritional status. As a composite indicator it has its own value, combining both acute and chronic influences. A limitation of weight-for-age is that it cannot distinguish between chronic and acute malnutrition. Weight-for-age, as in the case of the other two indicators of nutritional status (weight-for-height and height-for-age) is governed by such factors as food intake, incidence of disease, health care use, which are expected to be interrelated (8, 3). Considering all these points anthropometric indicators are thought to be valid for single as well as cumulative effects of food intake, disease and health care. For children in rural areas, it has been found that food intake is likely to be the main component determining weight-for-age (2).

To graphically test the relationship between rice price fluctuations and nutritional status, line graphs were drawn with rice prices and the indicators of nutritional status for the whole sample.

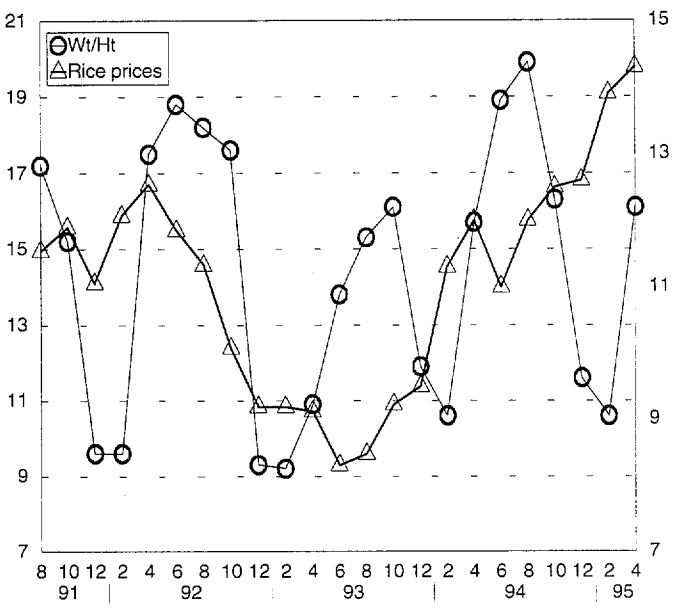

Figure 2. Percentage of children who are wasted and average rice prices

Based on the graphical results, descriptive analysis was done by stratifying sample households by per capita food expenditure quintiles. Stratified sample households were tested against the specified time periods (T1, T2, T3) using household distress, food expenditure, consumption and indicators of nutrtitional status of children 6-59 months to identify the impact on specific household and children in those households to fluctuation in rice prices.

As descriptive statistics are only suggestive and a host of intervening variables may be driving the difference or lack of difference among the sample household in the quintiles, multivariate analysis was done controlling for relevant household and child indicator.

3. Data

The data set utilized in this study is child based: each child 6-59 months is linked to a household. A total of 182,244 children were utilized in this study. Each quintile has between 33,500 to 37,700 children. Each time period specified has six rounds of data. In terms of food availability, the best season in rural Bangladesh is November through December, during which time the main crop, *Aman* is harvested. The nutritional benefits from that harvest and from other small harvests has been found to continue through the following April (2). Seasonality in food availability and the nutritional benefits from increased food availability is addressed by including December, February, and April rounds in each time period (Figure 1).

4. Graphical Results

Figures 2, 3 and 4 show rice prices against the indicators of nutritional status: weight-for-height, height-for-age, and weight-for-age. Wasting (weight-for-height), which reflects children's current nutritional status, seems to have a strong relationship with the price fluctuations. For example, during time period (T2) identified as the "Consumption Holiday", rice prices fall to their lowest levels and wasting rates decreased. Further, as rice prices increased in time period (T3), wasting rates rose (Figure 2). Stunting (height-for-age) refers to children who are too short for their age, and reflects past or chronic nutritional status, shows a declining trend from the (T2) or consumption holiday time period (Figure 3). One explanation is that the children are in the extended time periods, benefiting from the increased

consumption of food in the (T2) period. The Analysis of Poverty Trends project carried out by the Bangladesh Institute for Development Studies suggests that incidence of poverty in rural areas declined slightly between 1990 and 1993 with much of the gains being made in 92/93 (10). This study suggests that this very modest improvement in the poverty situation may be due to the pick up in economic growth following a slide in the early 1990s on the one hand, and on the other, the absence of major natural disasters and the positive impact of rural household nutrition due to the sharp decline in the price of rice (11). Underweight (weight-for-age), used in this study as the primary indicator of nutritional status is high in (T1) decreases dramatically in (T2) and rises again in (T3) following closely the rice price fluctuations (Figure 4).

5. Descriptive Analysis

Characteristics of sample households in each expenditure quintile

Socioeconomic status

Indicators of socioeconomic status such as land holding, occupation and type of labor, food expenditure, consumption and market dependency were used to provide a relative picture of households in each quintile.

Ownership of land has been found to be an important indicator of socioeconomic status in Bangladesh (12). Type of land holding, defined as cultivable and homestead land owned, for sample households was looked at by each expenditure quintile. The average land owned by households in the food expenditure quintiles varied. Households in the first expenditure quintile had the lowest decimal of land owned 35, and the households in the fifth expenditure quintiles had the highest average decimal land owned at 298 followed by the fourth at 155 decimals and third expenditure quintile at 67. The average land ownership for households in the second expenditure quintile was 45 decimals. For the entire sample, 35.2% of households were landless of which a majority were represented in the first three expenditure quintiles and mostly concentrated in the first expenditure quintile at 52.5%. Marginal land owners (1-50 decimal) who accounted for 23.2% of households in the entire sample, were again concentrated in the first three expenditure quintiles, with the first quintile showing the highest representation at 39.5%. The highest representation of small land owners (51-250 decimal) who accounted for 28.3% of the entire sample, were in the fourth and fifth expenditure quintiles; 20.7% and 46.1% respectively. Medium land owners (251-500 decimals) who accounted for 8.3% of the entire sample were mostly represented in the fourth and fifth expenditure quintile at 11.4% and 69.8% respectively. Only 5% of the household in the entire sample were large landowners (> 501 decimals) of which 79.7% were in the fifth expenditure quintile followed by the fourth expenditure quintile at 8.1%. Seventy five percent of households in the fifth expenditure quintile own land greater than or equal to 250 decimals and 46% own land in this range in the fourth expenditure quintile. Further, 80 % of households in the first expenditure quintile and 73 % in

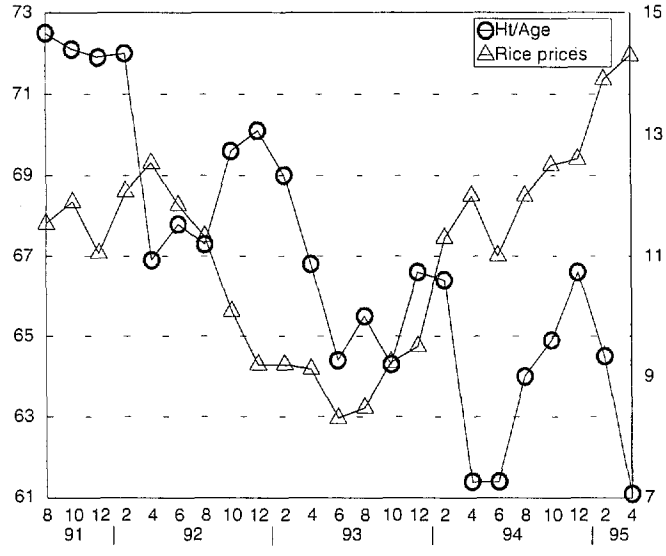

Figure 3. Percentage of children who are stunted and average rice prices

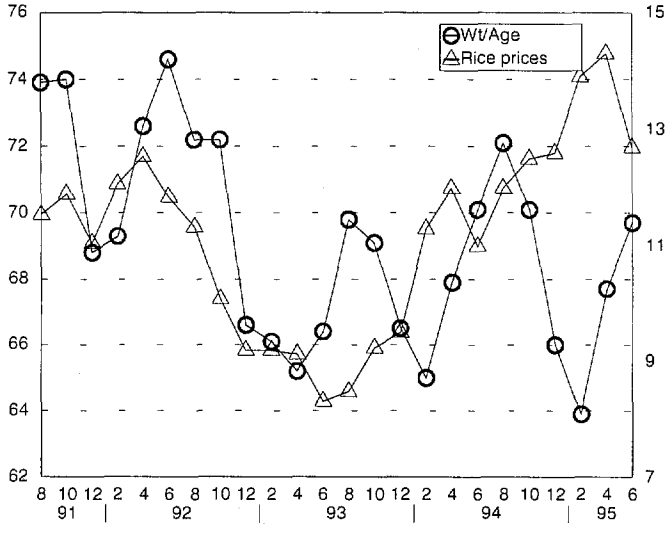

Figure 4. Percentage of children who are underweight and average rice prices

the second, 66.1% in the third own land less than or equal to 50 decimals (Table 1).

Fifty five percent of sample households either owned no land or were dependent on casual or short term labor. The majority of these vulnerable households (47%) were in the first, second and third expenditure quintile. The least representation of vulnerable households was in the fifth expenditure quintile (Table 2).

Occupation of main earners of sample household was looked at for each expenditure quintile. Main earners who were farmers accounted for 26.7% of the entire sample, of which 73% were in the fifth expenditure quintile and 10% in the fourth expenditure quintile. Day laborers accounted for 26.1% of the entire sample, of which the majority were in the first, second and third expenditure quintiles: 47.6%, 23.9% and 10.9% respectively. Fifteen percent of main earners in the sample were tradesmen/mechanics, of which the majority were in the first and second expenditure quintiles; 39% and 22% respectively. Nine percent of main earners in the sample were service holders, of which 36.7% were in the fifth expenditure quintile. Four percent of the main earners in the sample were rickshaw drivers or cart pusher or van driver or boatman, of which 42.6% of households in first expenditure quintile, 21% in the second and with least representation in the fifth expenditure quintile (Table 3).

Per capita monthly food expenditure was calculated for each expenditure quintile. The mean food expenditure for each household member in the first quintile was Tk 144 followed by Tk 206 for the second expenditure quintile, Tk 259 for the third, Tk 351 for the fourth, and Tk 542 in the fifth expenditure quintile. Rice or wheat consumed by households in the last week from own production was converted to Taka and added on to total food expenditure to ensure that small, medium and large landowners' food expenditure is not under estimated as they rely mostly on own production for consumption (Table 4).

Household food availability was assessed for households in each quintile using per capita rice, wheat and overall grain kcal intake per day. Households in the fifth expenditure quintile had the highest overall grain kcal intake at 1,853, followed by the fourth, third, second and first expenditure quintiles, respectively (Table 4). As expected, rice provides the majority of the grain kcal. Wheat contributes relatively more to overall grain intake in the first, second and third expenditure

	FEXQ1	FEXQ2	FEXQ3	FEXQ4	FEXQ5	Total
Landless	56%	48%	40%	22%	9%	35.2%
Marginal (1-50)	26%	27%	28%	22%	11%	23.2%
Small (51-250)	15%	20%	25%	37%	43%	28.3%
Medium (251-500)	1.5%	2.7%	4.6%	11.3%	20.9%	8.3%
Large (>500)	0.7%	0.8%	1.8%	6.2%	15%	5.0%
Total	34.4%	14.5%	10.2%	10.6%	30.3%	100%

average land owned in decimals - FEXQ1=33, FEXQ2=45, FEXQ3=67, FEXQ4=155 FEXQ5=298

Table 1. Land owned in decimals by food expenditure quintiles

	FEXQ1	FEXQ2	FEXQ3	FEXQ4	FEXQ5
DSX	8%	7%	7%	5%	3%
LOANX	27%	26%	23%	18%	9%
VULNERABLE	87%	80%	65%	39%	9%

*** refer to glossary for variable description*

Table 2. Household distress by quintiles

	FEXQ1	FEXQ2	FEXQ3	FEXQ4	FEXQ5
Farmer	8.4%	8.8%	11%	34%	60%
Laborer	42%	36%	34%	17%	5%
Tradesman	17%	21%	18%	13%	7%
Rickshaw puller	5%	6%	6%	3%	1%
Fisherman	5%	7%	6%	2%	0.9%
Other	23%	21%	25%	31%	22%

Table 3. Occupation of main earners in hosueholds by food expenditure quintiles

	FEXQ1	FEXQ2	FEXQ3	FEXQ4	FEXQ5
FEXPPC	144 Tk	206 Tk	259 Tk	351 Tk	542 Tk
KCALR	1267 kcal	1467 kcal	1557kcal	1599 kcal	1801 kcal
KCALW	95 kcal	93 kcal	87 kcal	71 kcal	52 kcal
KCALG	1362 kcal	1560 kcal	1644 kcal	1670 kcal	1853 kcal
FEXPG	79%	69%	55%	42%	30%
FEXPO	21%	31%	45%	58%	70%
MDEP	97%	97%	85%	41%	5%

*** refer to glossary for variable description*

Table 4. Household consumption and expenditure by quintiles

	FEXQ1	FEXQ2	FEXQ3	FEXQ4	FEXQ5
WAZ	-2.51	-2.44	-2.39	-2.33	-2.27
HAZ	-2.60	-2.52	-2.47	2.35	-2.28
WHZ	-1.23	-1.18	-1.15	-1.16	-1.13
WAZ2X	73.1%	70.7%	68.8%	66.1%	64%
HAZ2X	71%	68.5%	66.7%	63.1%	60.3%
WHZ2X	15.7%	14.8%	14.2%	13.8%	13.1%
WAZ3X	28.2%	25.2%	23.3%	21.5%	19.4%
HAZ3X	35.9%	33.8%	32.3%	28.4%	26.2%
WHZ3X	1.1%	1.0%	1.0%	0.9%	0.7%

Table 5. Nutritional status of children 6-59 months by quintiles

FEXQ1		T1 to T2	T2 to T3
Households distress	DSX	-10%	+3.1%
	LOANX	-11%	+1%
Household expenditure	RICEEXP	-13 Tk	+19 Tk
	WHEXP	-9 Tk	+7 Tk
	OTHEREXP	+19 Tk	-16 Tk
	%FEXPG	-16%	+14%
	%FEXPO	+15%	-13%
Household grain consumption	KCALR	+208 kcal	-234 kcal
	KCALW	-129 kcal	+89 kcal
	KCALG	+139 kcal	-149 kcal
Nutritional status of children (6-69 months)	WAZ	-.14	+.05
	HAZ	-.18	-.12
	WHZ	-.05	+.09
	WAZ2X	-4.9%	+1.2%
	HAZ2X	-6.8%	-2.0%
	WHZ2X	-2.7%	+3.4%

*** refer to glossary for variable description*

Table 6a. Variation in status of households from T1 to T2 and T2 to T3

quintiles. The lowest contribution of wheat to overall grain intake is in the fourth and fifth expenditure quintiles (Table 4). The per capita daily food grain intake recommended by the World Health Organization is 465 grams (14). The recommended gram conversion to kcal is 1,620 kcal per day. Based on the average intake levels for each quintiles, households in the third, fourth and fifth expenditure quintiles meet the recommended levels (Table 4).

Market dependency of households for purchasing grain was assessed for the sample households in each expenditure quintile. A household is classified as market dependent if over 50% of rice or wheat consumed came from the market. Sixty five percent of the sample households were dependent on the market as a source for grain (rice or wheat). Market dependent households are equally represented at 97% in the first and second expenditure quintiles. Eighty five percent of households in the third expenditure quintile and 41% in the fourth quintile are market dependent. Only 5% of the households in the fifth expenditure quintile are market dependent.

Nutritional status

Nutritional status of a child is expressed in the Z-score of the concerned indicator. Weight and height of children of a certain age group follow more or less a normal distribution. The height-for-age Z-score (HAZ) compares the height of a child of certain age with the median height of the reference population of that age group; the weight-for-age Z scores (WAZ) does the same for weight; and the weight-for-height Z-score (WHZ) compares the weight of a child of a certain height with the reference median weight for a child with the same height. The value of the Z-score is the number of standard deviations that the child is away from the median of the specific indicator of the children of the age/sex group from the reference population. The reference standards are those recommended by the World Health Organization (13). A Z-score of -2 is normally used as the cut off point to differentiate between well nourished and malnourished children. A Z-score of -3 is used as the cut-off for severe malnutrition.

Nutritional status of children in sample households in each food expenditure quintile were looked at using all three indicators of nutritional status. Using mean Z-scores, the nutritional status of children in the quintiles improves as one moves from the first expenditure quintile to the fifth (Table 5). The gap in status between first, second and third quintiles as well as between the fourth and fifth expenditure quintiles is significant.

Using the cut off points of < -2 SD and <-3 SD, the proportion of children falling into the categories of malnourished and severely malnourished decreases as one moves from the first expenditure quintile to the fifth expenditure quintile (Table 5). Once again, the difference in the proportion of children falling into <-2SD and <-3SD among the food expenditure quintiles is highly significant.

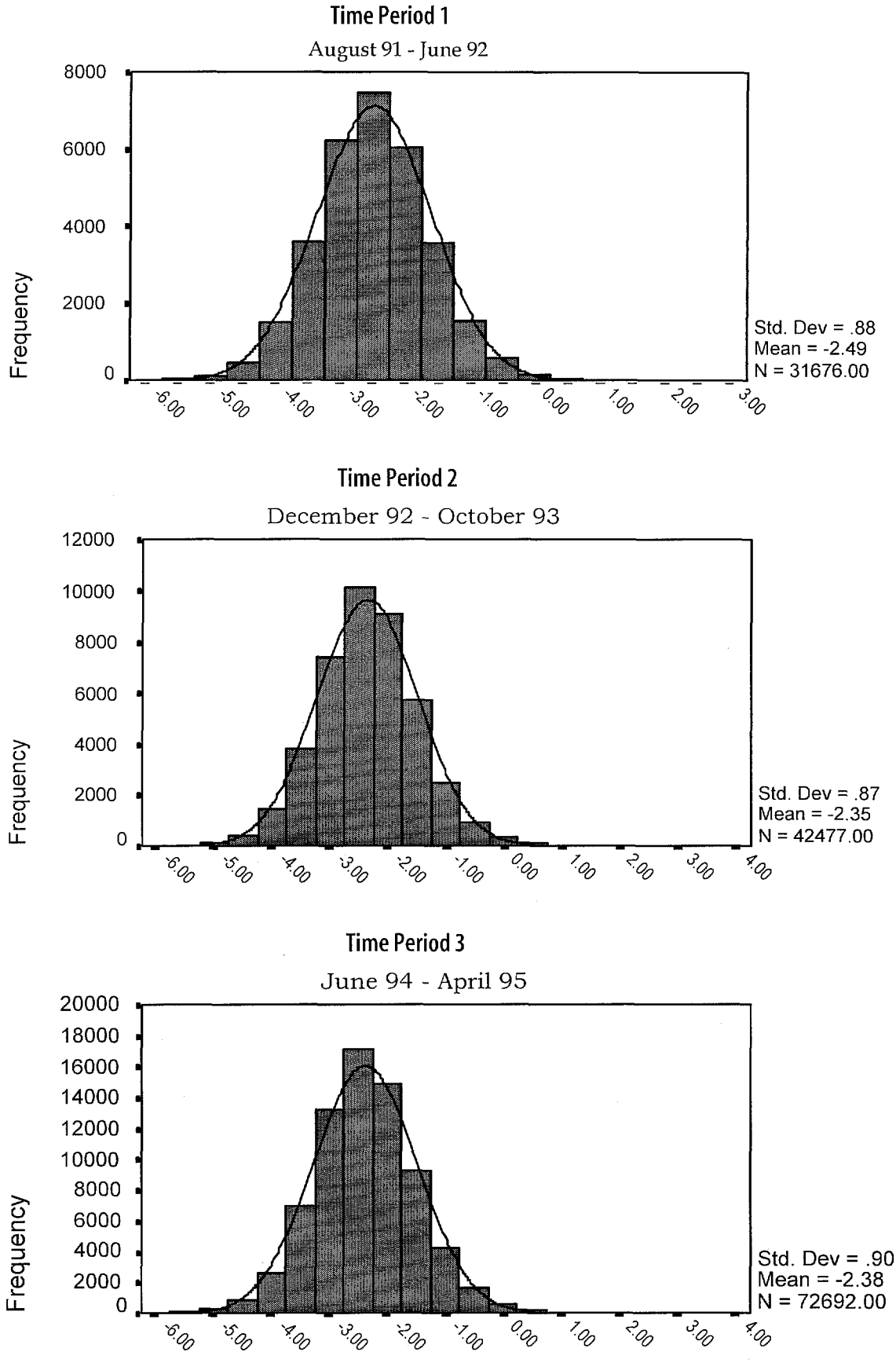

Figure 5. Weight-for-age Z-Score of children from rural households

Variations in socioeconomic status of households and nutritional status of children (6-59) months from T1- T2

Descriptive analysis was done for sample households in each per capita food expenditure quintile by the three specified time periods which reflect the variation in rice price. The analysis was done using the above mentioned indicators of nutritional and socioeconomic status to capture any variation in socioeconomic status of households and nutritional status of children as one moved from T1 to T3.

Children in all quintiles showed relative improvement in nutritional status from the "Control Period" (T1) to the "Consumption Holiday Period" (T2). However, the magnitude of improvement in nutritional status varied by quintiles.

Children in the fifth and fourth expenditure quintiles showed the greatest improvement in nutritional status measured by underweight followed by children in the second, first and third expenditure quintiles. Stunting levels showed the greatest improvement in the fifth and fourth expenditure quintiles followed by children in the first, second and third. Wasting levels showed the greatest improvement in the third and second expenditure quintiles followed by fifth, fourth and first food expenditure quintiles (Tables 6a-6e). For all households in the sample, nutritional status measured by weight-for-age improved (Figure 5).

Based on the weight-for-age ranking of improvement in nutritional status, children in the fifth and fourth expenditure quintiles benefited primarily because of (1) availability of rice from own production and (2) increased expenditure on other foods relative to grain (Tables 6d, 6e). As described above, households in the fifth and fourth expenditure quintiles are medium and large farmers. The decline in rice prices captured in T2 reduced the incentive to sell rice from own production. With excess rice available, households in these two quintiles consumed more from their own production (Tables 7b, 7c). This pattern is seen more so in the fourth expenditure quintile where rice from own production increased from 22% of all rice consumed in T1 to 73% in T2 (Table 7b). Households in the fifth expenditure quintile also increased consumption of rice and contribution of rice from own production increased from 83% in T1 to 89% T2.

Expenditure on other foods increased in proportion to decreased expenditure on grain among households in all quintiles. Household expenditure in quintiles 1 and 2 increased less than that of quintiles 3 and 4 (Tables 6a-6e). Households in quintile 5 increased their household expenditure on other foods the least as expected since they are consuming grain from own production and do not see any increases in household purchasing power with the decline in price of rice they produce to sell. However, households in the fifth and fourth expenditure quintiles maintain the higher proportionate expenditure on other foods among households in T2.

FEXQ 2		T1 to T2	T2 to T3
Households distress	DSX	-6.4%	+3.4%
	LOANX	-10%	+1%
Household expenditure	RICEEXP	-26 Tk	+28 Tk
	WHEXP	-9 Tk	+7 Tk
	OTHEREXP	+35 Tk	-35 Tk
	%FEXPG	-16%	+28%
	%FEXPO	+16%	-28%
Household grain consumption	KCALR	+40 kcal	-375 kcal
	KCALW	-127 kcal	+82 kcal
	KCALG	-87 kcal	-293 kcal
Nutritional status of children (6-69 months)	WAZ	-.15	+.13
	HAZ	-.14	-.08
	WHZ	-.11	+.18
	WAZ2X	-5.9%	+4.7%
	HAZ2X	-4.6%	-2.2%
	WHZ2X	-3.4%	+5.2%

*** refer to glossary for variable description*

Table 6b. Variation in status of households from T1 to T2 and T2 to T3

FEXQ3		T1 to T2	T2 to T3
Households distress	DSX	-8.9%	+2.9%
	LOANX	-7%	+1%
Household expenditure	RECEEXP	-46 Tk	+50 Tk
	WHEXP	-9 Tk	+7 Tk
	OTHEREXP	+60 Tk	-62 Tk
	%FEXPG	-21%	+23%
	%FEXPO	+21%	-23%
Household grain consumption	KCALR	+10 kcal	-38 kcal
	KCALW	-129 kcal	+82 kcal
	KCALG	-119 kcal	+44 kcal
Nutritional status of children (6-69 months)	WAZ	-.12	+.06
	HAZ	-.05	-.12
	WHZ	-.12	+.15
	WAZ2X	-4.0%	+2.3%
	HAZ2X	-1.5%	-2.1%
	WHZ2X	-2.3%	+3.9%

*** refer to glossary for variable description*

Table 6c. Variation in status of households from T1 to T2 and T2 to T3

With the exception of households in the fifth and first expenditure quintiles, overall kcal grain intake declined (Tables 6a-6e). The primary reason is the reduction in wheat intake in T2 among all households. That is with lower rice prices in T2 and rice being the preferred cereal among rural households, increased rice consumption was substituted for wheat among all households in T2. Decline in wheat intake was particularly high among the households in the first three expenditure quintiles, as wheat represents a higher a portion of intake in these households (Table 4).

FEXQ4		T1 to T2	T2 to T3
Households distress	DSX	-6.1%	+1.3%
	LOANX	-12%	+7.0%
Household expenditure	RIECEXP	-35 Tk	+43 Tk
	WHEXP	-8 Tk	+7 Tk
	OTHEREXP	+36 Tk	-52 Tk
	%FEXPG	-13%	+15%
	%FEXPO	+13%	-15%
Household grain consumption	KCALR	+3 kcal	-128 kcal
	KCALW	-105 kcal	+81 kcal
	KCALG	-102 kcal	-47 kcal
Nutritional status of children (6-69 months)	WAZ	-.16	+.11
	HAZ	-.24	-.04
	WHZ	-.08	+.17
	WAX2X	-6%	+4.3%
	HAZ2X	-3.8%	-05%
	WHZ2X	-2.1%	+4.1%

*** refer to glossary for variable description*

Table 6d. Variation in status of households from T1 to T2 and T2 to T3

FEXQ5		T1 to T2	T2 to T3
Households distress	DSX	-3%	+1%
	LOANX	-6%	+3%
Household expenditure	RECEEXP	-38 Tk	+35 Tk
	WHEXP	-2 Tk	+2 Tk
	OTHEREXP	+3 Tk	+3 Tk
	%FEXPG	-5%	+3%
	%FEXPO	+5%	-3%
Household grain consumption	KCALR	+25 kcal	-239 kcal
	KCALW	-19 kcal	+16 kcal
	KCALG	+6 kcal	-223 kcal
Nutritional status of children (6-69 months)	WAZ	-.22	+.10
	HAZ	-.25	-.03
	WHZ	-.08	+.11
	WAZ2X	-9.6%	+4.4%
	HAZ2X	-7.1%	+1.1%
	WHZ2X	-2.5%	+2.9%

*** refer to glossary for variable description*

Table 6e. Variation in status of households from T1 to T2 and T2 to T3

The increase in rice consumption was comparatively higher in the first and second expenditure quintiles (Tables 6a, 6b). Households in the first two quintiles increased their consumption of rice primarily by purchasing more in the market (Table 7a). Although households in these two quintiles increased expenditure on other foods in T2, the proportionate expenditure on grain remained higher than expenditure on other foods. The primary reason is the households purchase of rice at an increased rate from the market as they lacked any reserves from own production as these households are mostly landless and marginal farmers. So when rice prices declined, households in these two quintiles reduced wheat intake and purchased more rice from the market, and had little left over to shift their expenditure to other foods in the way households did in the fourth and fifth expenditure quintiles. On the other hand, households in the fourth and fifth expenditure quintiles were able to increase kcal intake of rice primarily through rice from own production and have resources available to increase expenditure on other foods from levels already significantly higher than the level of expenditure in the other three quintiles (Tables 7b, 7c).

Children in the third quintile benefited the least nutritionally as measured by weight-for-age in T2 (Table 6c). For households in this quintile, intake levels are not as high those in the fourth and fifth quintiles or as low as those in the first and second quintile. Households in this quintile are primarily marginal and small land holders. Households in this quintile increased rice consumption, but not as high as those in the first and second expenditure quintiles and reduced wheat intake at an equivalent level to those in the first and second expenditure quintiles. Households did consume more rice from their own production, but not at the level of those in the fourth and fifth quintiles. Households also increased expenditure on food other than grain, at a higher level than those in the first and second but not as high as those in the fourth and fifth quintiles.

Variations in socioeconomic status of households and nutritional status of children (6-59 months) from T2-T3

Nutritional status of children, measured by weight-for-age and weight-for-height in all quintiles deteriorated from T2 to T3 with the magnitude of decline varying among quintiles. Children in second, fourth and fifth quintiles showed highest deterioration nutritionally measured by underweight (6a-6e). For all households in the sample, nutritional status measured

by underweight deteriorated; from a mean Z-score of 2.35 in T2 to -2.39 in T3 (Figure 5). For wasting, children in second and fourth quintiles showed the greatest deterioration.

Height-for-age, the long term indicator of nutritional status continued its improvement in all quintiles from T2. However, the magnitude of improvement slowed in all quintiles and varied by quintiles (Tables 6a-6e).

Once again households in the second, fourth, and fifth expenditure quintiles showed the greatest socioeconomic impact in T3. Rice intake across the quintiles declined in T3 and wheat intake increased dramatically in the first four quintiles. Overall grain intake declined in all quintiles, except third (increase from T2 but less than T1 levels (Table 7b)) and dramatically so in the fifth and second ones. Expenditure on other foods dramatically declined in the first three quintiles, while households in the fourth and fifth quintiles maintained higher expenditure on food other than grain in this time period (Tables 6a-6e).

There are three main reasons why households in the fifth and fourth expenditure quintiles show deterioration in nutritional status. First, households in the fourth and fifth quintiles are medium and large farmers; with higher rice prices, there is an incentive to sell which leads to less grain available for consumption. Secondly, cash income from sale of crops may not necessarily be spent on food. A combination of these two events most likely leads to reduced food consumption by children of interest. Thirdly, overall per capita paddy production for households in these two quintiles declined in T3. One reason is the possible high price of agricultural inputs, particularly fertilizer, in late 1994 and early 1995. Per capita paddy production for households in the fourth expenditure quintile declined from 0.75 *Maunds* in T2 to 0.16 *Maunds* in T3 and for households in the fifth expenditure quintile from 0.89 *Maunds* in T2 to 0.83 *Maunds* in T3. With the incentive to sell in T3 and overall reduction in per capita paddy production, per capita grain consumption dramatically declined for households in the fifth expenditure quintile from 15.7 kg in T2 to 13.8 kg in T3; a level of intake almost equivalent to those in the third expenditure quintile (Tables 7b, 7c). Grain intake measured by kcal per day declined by 223 from T2 to T3. A similar pattern was evident for households in the fourth expenditure quintile. However, overall grain intake decline was less dramatic as they supplemented with more wheat in T3.

The reasons for decline in nutritional status of households in the second expenditure quintile who showed equivalent decline in nutritional status to those in the fifth and fourth expenditure quintiles, was different. As described previously, these households are mostly landless and marginal households. Own production of rice was not a major source or source that

FEXQ 1	T1	T2	T3
GPC	11.38 kg	11.75 kg	10.88 kg
RM	86%	95%	89%
WM	10%	1.6%	8%
QP	.03 mounds	.06 mounds	.03 mounds
FEXQ 2			
GPC	14.22 kg	12.70 kg	12.68 kg
RM	90%	83%	92%
RO	0.9%	14%	.03%
WM	7%	3%	7%
QP	.04 mounds	.21 mounds	.03 mounds

*** refer to glossary for variable description*

Table 7a. Major sources of rice and wheat and overall grain intake

FEXQ 3	T1	T2	T3
GPC	14.76 kg	12.40 kg	13.42 kg
RM	85%	50%	90%
RO	5%	46%	2%
WM	8%	0.6%	6%
QP	.08 mounds	.47 mounds	.04 mounds
FEXQ 4			
GPC	14.23 kg	12.93 kg	13.39 kg
RM	67%	25%	83%
RO	22%	73%	10%
WM	7%	0.2%	4%
QP	.34 mounds	.75 mounds	.16 mounds

*** refer to glossary for variable description*

Table 7b. Major sources of rice and wheat and overall grain intake

FEXQ 5	T1	T2	T3
GPC	15.29 kg	15.71 kg	13.8 kg
RM	11%	9.4%	12.6%
RO	83%	89%	83%
WM	1.2%	1.3%	0.9%
WO	2.2%	1.1%	2.7%
QP	.90 mounds	.89 mounds	.83 mounds

*** refer to glossary for variable description*

Table 7c. Major sources of rice and wheat and overall grain intake

could sustain them at any time. Market purchase was the primary source (Table 7a). So when one moves from T2 to T3, with higher rice prices, households reduce consumption of rice and increase consumption of wheat. The decrease in rice consumption was so dramatic, 375 kcal, that increase in wheat intake did not offset the decrease in rice intake and therefore there was an overall decline in grain intake (Table 6b). Proportionate, expenditure on grain reverted back to T1 levels where the majority of food expenditure was grain expenditure. In T3, grain expenditure exceeds T1 levels by 12%. For households in the second expenditure quintile, consumption opportunities were dramatically reduced with higher rice prices as evident in proportional expenditure on food other than grain (Table 6b).

6. Multivariate Analysis

Since descriptive statistics are only suggestive and a host of intervening variables may be driving the difference or lack of difference among the sample households in the quintiles, multivariate analysis was done. Because nutritional status of children is affected by so many economic, social, environmental, maternal and child-specific variables, analysis was controlled for relevant socioeconomic, demographic and child health variables using a simple multiple regression model. The dependent variable in this model, testing for nutritional status, was weight-for-age. The three different time periods (T1, T2, T3) used in the analysis were added as independent variables to test the impact the time periods identified (which control for seasonality and reflect different levels of rice price) had on nutritional status. Finally, the sample as in the descriptive analysis, is disagregated into per capita food expenditure quintiles, with simple multiple regression being run on each group in order to capture any income interaction effects that may exist and separate out by expenditure quintiles the magnitude of impact each variable has on nutritional status.

	FEXQ1	FEXQ2	FEXQ3	FEXQ4	FEXQ5
Season(2)	.022\6.6	.020\5.6	.020\5.6	.019\5.9	.021\5.2
Season(3)	-.008\-2.6	-.008\-2.2	-.010\-2.8	-.011\-3.2	-.009\-2.3
Time(2)	.452\6.3	455\6.54	447\6.3	.465\7.02	536\7.4
Time(3)	-.359\-3.9	-403\-3.8	-336\-3.5	-.408\-4.3	-.417\-4.3
Diarrhea	-.216\-16.01	-.204\-16.0	-205\-15.5	-.226\-15.7	-190\-13.7
Sex	-.108\-12.11	-.076\-7.9	-.060\-6.6	-.083\-8.7	-.079\-8.7
AGE(12-23)	-.211\-19.22	-.201\-17.03	-187\-16.6	-.183\-15.7	-.151\-13.6
R - Square	*0.025*	*0.019*	*0.021*	*0.021*	*0.018*
F - Statistics	*145*	*108*	*104*	*107*	*99*

** estimated coefficient/t-score*
*** all coefficients significant at P>0.05*

Table 8a. Multivariate analysis - weight-for-age by food expenditure quintile

	Estimated Coefficients	T-Score
Infex	.178	41.0
Time (2)	.020	13.0
Time (3)	-.008	-6.0
Season(2)	.463	15.02
Season(3)	-.358	-8.0
Diarx	-.210	-34.0
Sex	-.081	-20.0
Ageb	-.187	-37.0
R - square - .029		

** all coefficients significant at p>0.01*

Table 8b. Multivariate analysis for aggregate data

General estimating model: estimate the impact of rice price on nutritional status, disagregated by per capita food expenditure quintile using linear regression model. C=f(y, t, x) where C=anthropometric measure, y=households income measured by expenditure quintile, t=time periods, x=set of variables hypothesized to influence the dependent variable.

The dependent variable used in the analysis is mean weight-for-age Z-score, as a continuous variable. The independent variables are: (1) Time period 2 and time period 3, which test the impact on nutritional status independently for "Consumption Holiday Period" and "High Rice Price Period" by quintiles. The variation in the magnitude of impact by quintiles for each time period will be captured (2) Season 2 and season 3 isolate the increased availability of food from December and nutritional benefits seen through April from both the time periods (3) Age isolates children 12-23 months who have been found to be at greater risk of malnutrition (4) Sex isolates female children who have been found to at greater risk of malnutrition (5) Diarrhea is added to isolate its influence on the dependent variable.

The independant variables are: (1) time period 2 - "Consumption Holiday Period"=1 (2) time period 3 - "High Rice Price Period"=1 (3) season 2 - December 1992 through April 1993=1 (4) season 3=December 1994 through April 1995=1 (5) age - 12 through 23 months=1 (6) sex - female=1 (7) diarrhea - yes=1.

The results of the regression analysis show that time periods, time period 1 or "Consumption Holiday" and time period 2 or "High Rice Price Period" had a highly significant effect on child nutrition. Effect of kcalg, age, sex diarrhea and season were also significant.

In terms of time period, the primary interest of this study, signs and the magnitude of the coefficients which estimates the impact, varied by quintiles. First of all, time period 2 or "Consumption Holiday Period" had a positive coefficient for all quintiles. The coefficient was more significant in the fifth followed by the fourth and second expenditure quintiles. That is "Consumption Holiday Period" had a positive effect or reduced undernutrition measured by weight-for-age and more so in the fifth, fourth and second expenditure quintiles. Time period 3, or "High Rice Price Period" had a negative coefficient for all quintiles. The negative coefficient was more significant in the fifth followed by the fourth and second expenditure quintiles. That is "High Rice Price Period" had a negative impact or increased undernutrition measured by weight-for-age and more so in the fifth, fourth and second expenditure quintiles (Table 8a).

Simple multiple regression analysis was also run on the aggregate data, that is combining households in all quintiles, to test the significance of the time periods. All dependent variables used in the stratified data analysis were included in the model with the addition of long transformation of per capita food expenditure to test independently the influence on nutritional status. As table 8b shows, the time periods are significant with T2 showing a positive significant coefficient and T3 showing negative significant coefficient. Further per capita food expenditure is highly significant and contributes positively to nutritional status of child.

7. Conclusions

Ownership of land plays a fundamental role in both low and high rice price periods. Children from households which have land, particularly medium and large land owners represented in the fourth and fifth expenditure quintiles benefited in the "Consumption Holiday Period". During this relatively lower rice price period, these househoolds were able to consume more of their own production since less of their own production was sold. The availability of rice from own production most likely increased grain consumption among the children of interest; the resulting benefit is evident in the dramatic improvement of nutritional status of children in these two quintiles. Further, households in these two quintiles increased their expenditure on other foods (significant increase for households in the fourth quintile, which is represented by more market dependent households than those in the fifth quintile) with the supply of rice for consumption remaining relatively stable.

Land also played a significant role for children from households in the second expenditure quintile, which ranked third in terms of nutritional benefit measured by underweight in the "Consumption Holiday Period". These households are mostly landless and marginal households and in the "Consumption Holiday Period" with relatively lower rice prices, they purchased more rice from the market and had the opportunity to spend more on other foods. This increase in real income, due to the decline in rice prices, which accounts for a significant portion of food expenditure for these households, translates into increased food availability. Increased food availability, evident by increased per capita intake and expenditure, coincides with improved nutritional status among children in these households.

From "Consumption Holiday Period" to "High Rice Price Period" households in the fourth and fifth expenditure quintiles experienced two events. First, with the relatively higher prices, the incentive to sell depleted reserves from own production. Second, per capita paddy production declined for both quintiles, especially for the fourth. These two events are reflected in the overall decline in per capita grain intake both in kg (week intake) and kcal (daily intake) for households in the two quintiles, resulting most likely in reduced food grain intake among the children. The reduction in food grain intake coincides with the dramatic deterioration in nutritional status among children in these households.

Households in the second expenditure quintile consumed less rice and more wheat due to the increase in rice prices; thus overall grain intake levels dropped. On the expenditure side, households reverted back to T1 expenditure levels on grain and expenditure on other foods dramatically declined. This overall reduction in grain intake levels and the reduction in other food expenditure by the households coincides with deterioration of nutritional status of children in these households.

A startling picture that emerges from this analysis is the high level of dependency of households across the

quintiles on grain (particularly rice) for both consumption and production. Households in the fourth and fifth expenditure quintiles with a relative higher purchasing power were still unable to cope in T3 when the incentive to sell increased and at the same time production levels dropped. As shown by the expenditure indicators in T3, households in fourth and fifth expenditure quintiles decreased expenditure on other foods and increased expenditure on grains, particularly rice. Overall grain intake dropped as rice from their own production was no longer a viable source. For households in the lower quintiles, such as those in the second expenditure quintile, the dependency on grain is even greater. When price of rice dropped in T2, there was increased consumption of rice primarily by purchasing more rice from the market. However, limited purchasing power restricted households in spending more on other foods as proportionate expenditure on grain relative to other foods still dominates food expenditure in T2. For the same households in T3, when rice prices increased there was a dramatic increase in grain expenditure and an equivalent decline in expenditure on other foods.

The "Consumption Holiday" clearly had a very positive impact on nutritional status, constituting what was arguably the most successful nutrition intervention in Bangladesh's history. Clearly agricultural policies which can sustainably increase production of rice and sustainably reduce price will have a positive impact on children in rural Bangladesh.

Poor households, such as those in the first three quintiles, cannot afford enough food to eat. Their dependency on grain, particularly rice, makes them clearly vulnerable to market price fluctuations. This is shown in the average malnutrition rates. These households will continue to suffer from higher malnutrition unless their purchasing power increases. For these households, it is essential to invest in household production schemes such as homestead gardening, poultry and fish rearing which both increases household food availability directly and indirectly through improving their purchasing power. Further, during times of crisis, these households resort to purchasing wheat as an alternative to rice. Changing food habits slightly to increase the perceived desirability of wheat could have a sustained positive impact on nutritional status. A pilot activity should be undertaken to assess if a social marketing approach could improve the consumption of wheat and sustainably increase the proportion of wheat in the diet.

For households which are land owners, like those in the fourth and fifth expenditure quintiles, two issues emerge from this analysis. First, there is a real need for crop diversification on the production side in order to reduce the dependency of farmers on rice production. Further, these households will also benefit from household production schemes, in particular homestead gardening, which provides an alternative consumption source and reduces dependency on pure grain consumption.

8. Future Studies

This study provides a foundation for further in-depth analysis into the issues of grain consumption, market prices and nutritional status in Bangladesh.

Areas for future studies are: (1) Rice prices and regional variation in nutritional status (2) Using rice price as a direct indicator, and running a time series analysis to evaluate lagged impact of rice price fluctuations on nutritional status (3) Analyzing the variation in impact of rice price fluctuation on households with more than one child 6-59 months old (4) Variation in nutritional status by gender in relationship to fluctuation in rice prices and (5) Analyzing the extent to which homestead vegetable production and or involvement in NGO activities buffers impact of rice price fluctuations.

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Glossary of Terms

(1) **Aman** - Largest of the three main rice crops grown and is harvested November to January.

(2) **Aus** - One of the three main rice crops grown and is harvested from July to September.

(3) **Boro** - One of the three main rice crops grown and is harvested from April to June.

(4) **Decimals** - 100 Decimals = 1 Acre.

(5) (**DSX**) Distress sale - percentage of households making distress sale, such as livestock, household items, agriculture equipment, household items etc., in the last 2 months.

(6) (**FEXPG**) Percentage of per capita food expenditure spent on grain - per capita grain expenditure divided by per capita food expenditure.

(7) (**FEXPO**) Percentage of per capita food expenditure spent on food other than grain - per capita food expenditure on food other than grain divided by per capita expenditure on food.

(8) (**FEXPPC**) Per capita food expenditure - food expenditure in the last three days converted to monthly expenditure divided by family size.

(9) (**FEXQ1 -FEXQ5**) Per capita food expenditure quintiles - per capita food expenditure quintiles, 1 through 5 used to desegregate the households for descriptive and multivariate analysis.

(10) (**GPC**) Per capita grain intake - this is calculated from rice and wheat consumed in the last 7 days in kg from own production, market, relatives and friends and aid sources and converted to monthly intake per person.

(11) (GRAINEXP) Per capita grain expenditure in the last month - is calculated by summing up per capita rice expenditure and wheat expenditure.

(12) (**KCALG**) Per capita kilocalorie intake of grain (rice+wheat) per day - it is a summation of per

capita kilocalorie rice and wheat intake.

(13) (**KCALR**) Per capita kilocalorie intake of rice per day - per capita rice intake in the last 7 days from the mentioned sources is converted to daily rice intake using kilocalorie conversion

(14) (**KCALW**) Per capita kilocalorie intake of wheat per day - per capita wheat intake in the last 7 days from the mentioned sources is converted to daily rice intake using kilocalorie conversion.

(15) (**LOANX**) Loans for food consumption - percentage of household taking out loans for food consumption in the last two months.

(16) **(LNFEX)** Log transformation of per capita monthly household food expenditure.

(17) **Maunds** - 37.5 Kg = 1 Maund.

(18) (**MDEP**) Percentage of market dependent household - percentage of grain consumed where over 50% is purchased from the market.

(19) **NSP** - Nutrition Surveillance Project.

(20) (**OTHEREXP**) Per capita expenditure on other foods in the last month - is calculated by subtracting per capita grain expenditure (per capita rice+wheat expenditure) from total food expenditure. The total food expenditure is asked on a three day recall period. The initial conversion involves converting from three days to month.

(21) (**PD**) Per capita paddy produced in mounds - monthly paddy production in mounds divided by family size.

(22) (**RICEEXP**) Per capita rice expenditure in the last month - is calculated using household market purchase of rice in kg in the last week and is converted to Taka value using current market price and is divided by household size to convert to per capita units. For farmers who produce their own rice and consume it, own production of rice consumed in kg is converted to Taka value using market price in the village household resides in and is added to the household rice expenditure.

(23) (**RM**) Percentage of overall rice consumed that was purchased from the market - rice consumed purchased from the market in the last week in kg divided by overall rice consumed from the mentioned sources.

(24) (**RO**) Percentage of overall rice consumed from own production - rice from own production in the last week in kg divided by overall rice consumed from the mentioned sources.

(25) **Stunting** - The percentage of children 6-59 months with height-for age < -2 Z-scores, chronic malnutrition.

(26) **Standard deviation scores (Z-score)** - Measures how far a child's nutritional status deviates from the internationally accepted reference population (NCHS). Malnutrition is defined as less than -2 standard deviations from the mean (< -2 Z-scores).

(27) **Thana** - In rural areas, sub-districts are referred to as *Thanas* in Bangla.

(28) **Underweight** - The percentage of children 6-59 months with weight-for-age < -2Z-scores.

(29) (**VULNERABLE**) Percentage of households who are classified as vulnerable households - households who are landless or who rely on casual or short term labor for income are vulnerable.

(30) **Wasting** - The percentage of children 6-59 months with weight-for-height < -2 Z-scores, acute malnutrition.

(31) *(WHEXP)* Per capita wheat expenditure in the last month - is calculated using household market purchase of wheat in kg in the last week and is converted to Taka value using current market price and is divided by household size to convert to per capita units. For farmers who produce their own wheat and consume it, own production of rice consumed in kg is converted to Taka value using market price in the village household resides in and is added to the household wheat expenditure.

(32) (**WM**) Percentage of overall wheat consumed purchased from the market - wheat consumed purchased from the market in the last week in kg divided by overall wheat consumed from the mentioned sources.

(33) (**WO**) Percentage of overall wheat consumed from own production - wheat consumed purchased from the market in the last week in kg divided by overall wheat consumed from the mentioned sources.

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Attachment 1

Sentinel Sites and Partner Organizations in the Nutritional Surveillance Project

Districts	Thanas or Slums	Current Organizations	Starting Date
Dhaka	Ward 60	Dhaka Urban Community Health Program	April, 1990
	Ward 62	Dhaka Urban Community Health Program	April, 1990
Tangail	Mirzapur	Bangladesh Rural Advancement Committee [1]	April, 1990
	Shakhipur	Bangladesh Rural Advancement Committee [1]	April, 1990
	Bhuapur	NGO not selected	October, 1996
Sirajganj	Kazipur	Bangladesh Rural Advancement Committee [2]	December, 1990
	Raiganj	Gono Kallyan Sangstha [2]	December, 1990
Cox's Bazar	Moheshkhali	Society for Health and Development [3]	April, 1992
	Teknaf	Society for Health and Development [3]	April, 1992
Chandpur	Matlab	International Center for Diarrheal Disease Research	April, 1990
Comilla	Daudkandi	International Center for Diarrheal Disease Research	April, 1990
	Chouddagram	Comilla PROSHIKA	October, 1994
	Brahmanpara	NGO not selected	October, 1996
Khulna	Khulna Slums	CONCERN	April, 1990
Chitagong	Chittagong Slums	CONCERN	April, 1990
	Rangunia	Family Planning Association of Bangladesh	October, 1994
Dinajpur	Fulbari	Institute of Public Health Nurtrition [4]	April, 1994
	Khansama	Plan International [5]	October, 1995
Bhola	Charfesson	Action Aid [5]	October, 1995
Manikganj	Saturia	Bangladesh Rural Advancement Committee	April, 1990
Pabna	Santhia	Bangladesh Rural Advancement Committee	April, 1990
Madaripur	Rajoir	Gono Unnayan Prochesta	April, 1990
Gopalganj	Gopalganj	Gono Unnayan Prochesta	April, 1990
Kurigram	Chilmari	Rangpur Dinajpur Rural Service	April, 1990
Thakurgaon	Pirganj	Rangpur Dinajpur Rural Service	April, 1990
Bagerhat	Morrelganj	Institute of Public Health Nurtrition [4]	April, 1991
Patuakhali	Mirzaganj	Institute of Public Health Nurtrition [4]	April, 1991
Rajshahi	Mohanpur	Christian Commission for Development in Bangladesh [5]	April, 1994
Noagaon	Manda	Christian Commission for Development in Bangladesh [5]	April, 1994
Jessore	Jhikargacha	Institute of Public Health Nurtrition [4]	April, 1994
Moulvibazar	Kamalganj	Institute of Public Health Nurtrition [4]	April, 1994
Kushtia	Daulatpur	Institute of Public Health Nurtrition [4]	April, 1994
Sunamganj	Derai	Grameen Jano Kallyan Sangsad	October, 1994
Sylhet	Golapganj	Grameen Jano Kallyan Sangsad	October, 1994
Brahmanbaria	Sarail	Comilla PROSHIKA	October, 1994
Sherpur	Nakla	Family Planning Association of Bangladesh	October, 1994
Borguna	Pathorghata	Association for Social Advancement	October, 1995
Netrokona	Kandua	Association for Social Advancement	October, 1995
Kishoreganj	Pakundia	Palli Bikash Kendra	October, 1995
Gaibandha	Palashbari	Sinnomul Mahila Samity	October, 1995
Satkhira	Shyamnagar	Dhaka Ahsania Mission	October, 1995
Bogra	Nandigram	NGO not selected	October, 1996
Rajbari	Pangsa	NGO not selected	October, 1996
Feni	Dagunbhuiya	NGO not selected	October, 1996
Chapai Nawabganj	Shibganj	NGO not selected	October, 1996

[1] CARE collected data from April 1990 through March 1993.

[2] ICDDR,B collected data from December 1990 through September 1992. Proshika MUK collected from October 1992 through November 1995.

[3] Bangladesh Red Crescent Society collected data from April 1992 through September 1993.

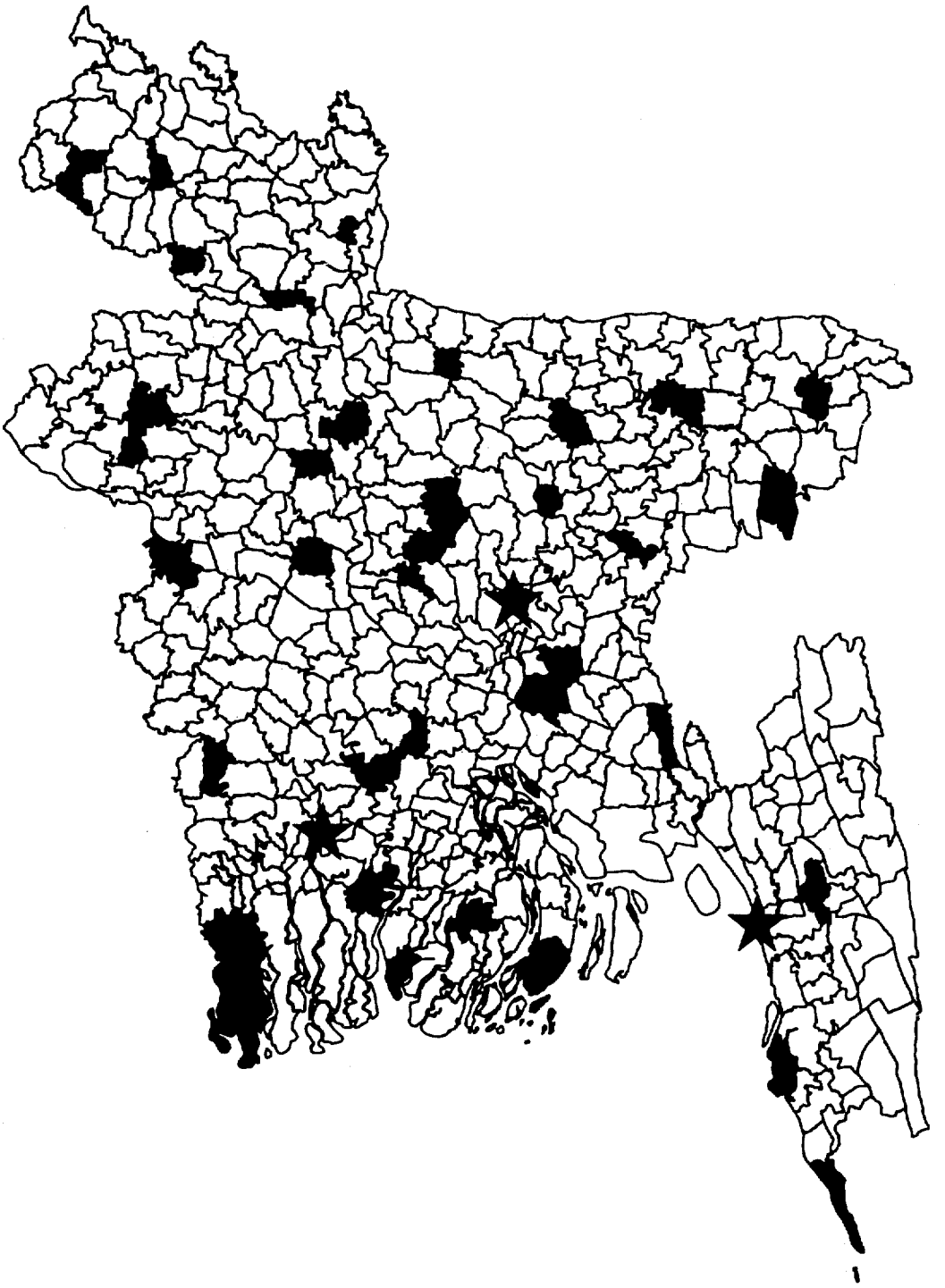
[4] Field costs are financed by UNICEF.

[5] Partner participates in the NSP at their own cost.

Attachment 2

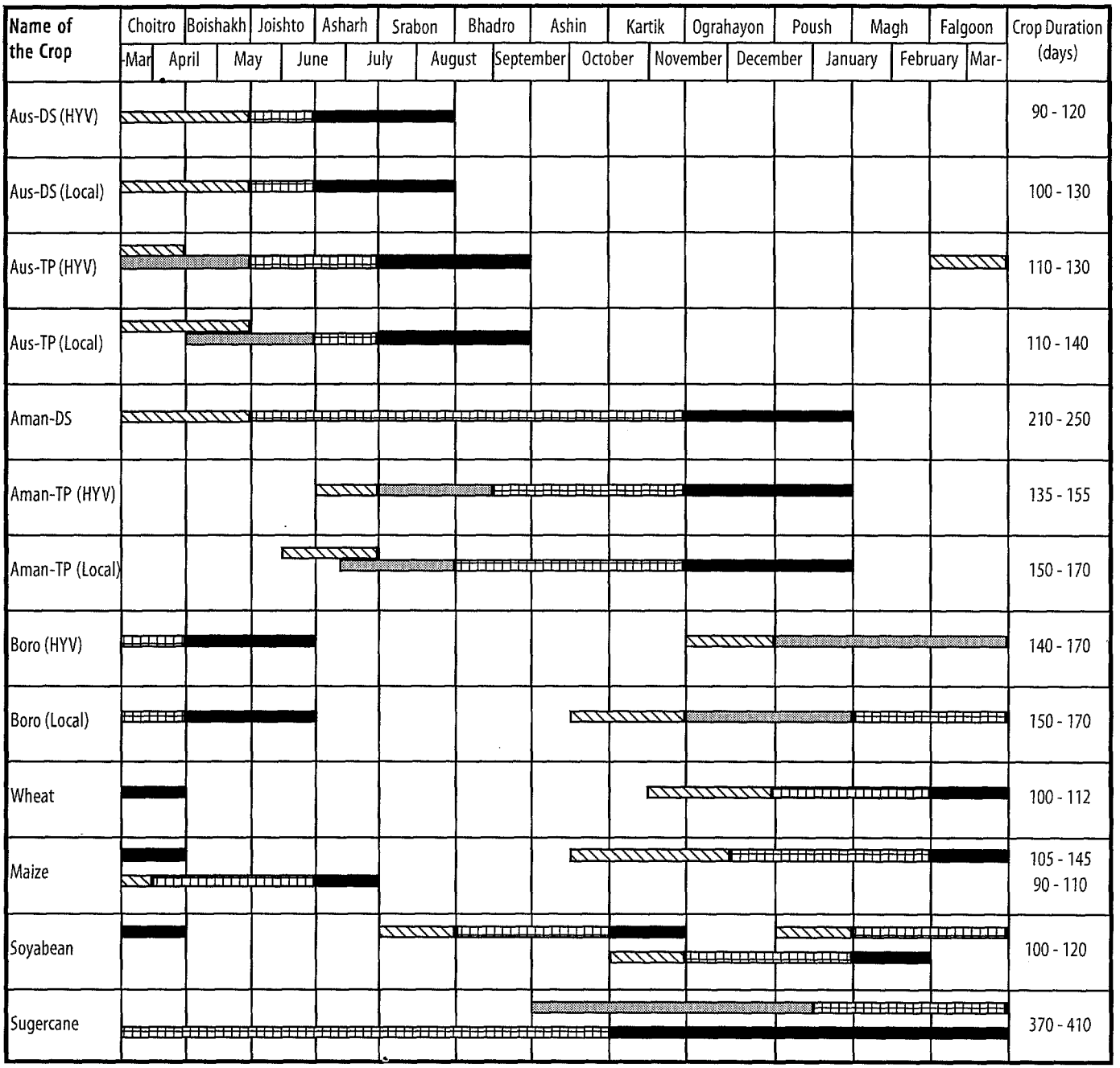
Map of Sentinel Sites Currently Operational in the Nutritional Surveillance Project

August 1996



Attachment 3

Agriculture Crop Calendar for Bangladesh



Legend:

DS Direct Sowing

TP Transplanting

Sowing Time

Transplanting Time

Growing Stage

Harvesting Time