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THE INTERACTION OF NUTRITION, INFECTION, AND MORTALITY DURING RECENT FOOD CRISES IN BANGLADESH†

This paper presents data on the demographic impact of two contemporary Bangladesh famines, one associated with war in 1971 and the other with crop failure in 1974. Fluctuations of births, deaths, and migrations are analyzed and disaggregated. From such empirical data, an analytical framework delineating the multiple, interacting causes and consequences of famine is constructed. The framework postulates that several mutually-reinforcing vicious cycles, between infection and malnutrition and between the three demographic variables, contribute to the impact of acute nutritional crises. The implications of these findings for preventive and remedial interventions are discussed in the conclusion.

Famine has been defined as "a severe food shortage accompanied by a significant increase in local or regional death rates" (*4*, p. 190). The demographic component of this definition is clear: famine is a disaster characterized by large numbers of excess deaths. The strength of this definition however is also its weakness for simplicity often obscures more than it reveals. Famine in fact is a complex syndrome of multiple interacting causes and diverse manifestations, and it involves all three demographic variables—mortality, fertility, and migration. A sound understanding of the complex mechanism by which disaster overwhelms the social, economic, and demographic stability of a society is essential not only for effective remedial action but also for long-term prevention.

Since 1970 Bangladesh unfortunately has experienced two tragic famines. The first in 1971 was precipitated by the Bangladesh War of Independence with Pakistan. Military hostilities caused widespread food shortages by disrupting agricultural production (dislocation of agricultural services, supplies, and labor-

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ers) and impeding the delivery, transport, and distribution of imported foodgrain, which accounted for 15 percent of total foodgrain availability (6). Per capita cereal consumption fell from the subsistence baseline level of 15 ounces daily to a near starvation level of 12 ounces (1,200 calories). Malnutrition and deaths increased markedly. The second disaster in 1974 was caused by severe monsoon flooding which destroyed the rice crops in selected areas during the *aus* (minor rice crop) and *aman* (major rice crop) seasons. The rice crops grown during those two seasons account for about 25 and 60 percent, respectively, of total foodgrain production. Crop failure led to unemployment, hoarding, and escalating rice prices, which eroded the purchasing power of the poor (1). Foodgrain consumption was compromised; malnutrition and the death rate again increased sharply.

These disasters provided a unique opportunity for the study of famine. Both crises affected Matlab *thana* (an administrative unit), a riverine rural area with a population of 200,000 located 40 miles from the capital city of Dacca. And since 1966 the Cholera Research Laboratory (CRL) has maintained a longitudinal vital registration system in Matlab thana. These data are of high quality and avoid the errors associated with retrospective interviews as well as provide a unique micro-level record of the demographic impact of two contemporary nutritional crises. Details of the CRL demographic data collection system and of its reliability have been reported earlier (*14*).

DEMOGRAPHIC FLUCTUATIONS

Table 1 presents a summary of demographic rates in Matlab thana for ten complete years, 1 May 1966 to 30 April 1976.[1] As the data indicate, the two contemporary disasters were associated with profound changes on all three demographic variables—births, deaths, and migrations. One year after the war (1972-73) the birthrate declined modestly, but in the following year (1973-74) the rate climbed to the highest level recorded in the decade of observation. The rate fell again in 1974-75, the year of flooding, and declined dramatically one year after the 1974 famine. After reasonably stable levels in the 1960s, the death rate climbed markedly during the 1971 war. In 1972-73 some recovery was noted but full recovery was not attained until 1973-74. The 1974 famine marked the onset of another sharp increase of the death rate and recovery, although detectable, remained incomplete in 1975-76. The out-migration rate changed in a consistent pattern in response to the crises, increasing during both disruptions. In-migration, however, fluctuated paradoxically, rising in 1971-72 and declining in 1974-75. The overall effect of these fluctuations was a decline of the rate of natural increase during and immediately following the disasters. These declines reflected marked increases of deaths during the crises and a combination of reduced births and incomplete recovery of deaths one year following the disasters. As a result of the combined effects of net migration and the fluctuations in vital rates, the population growth rates during and immediately following the crises were greatly reduced. The growth rates even became negative in 1974-76.

[1] The CRL data reported here were processed in Bangladesh by countersorter. The data are currently being edited, cleaned, and checked for internal consistency. Findings from other analyses of these data, therefore, may differ in minor respects from this report. The differences, if any, are likely to be minor and would not affect the basic conclusions of this study.

TABLE 1.—DEMOGRAPHIC RATES IN MATLAB THANA, BANGLADESH, 1966-67 to 1975-76*
(crude rates per thousand)

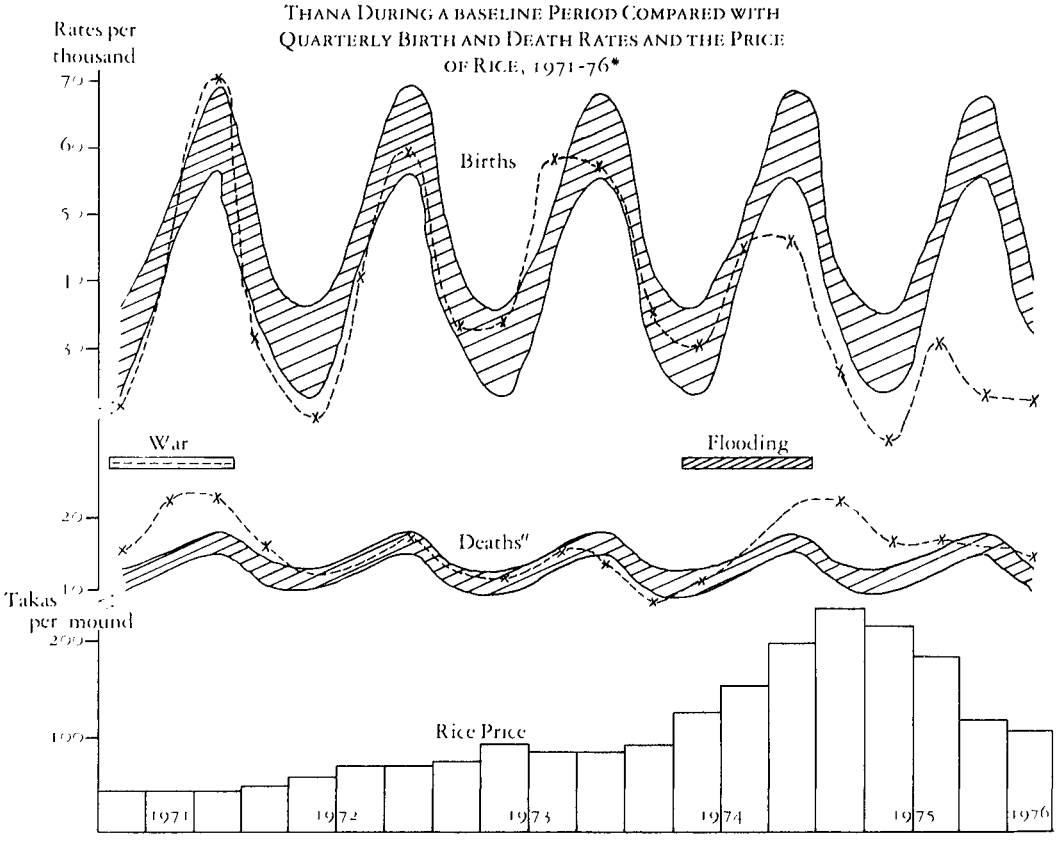
Rates	1966-67	1967-68	1968-69	1969-70	1970-71	(War) 1971-72	1972-73	1973-74	(Flooding) 1974-75	1975-76
Births	46.8	45.2	46.4	45.2	43.6	44.5	41.8	47.8	40.1	27.6
Deaths	16.0	17.2	15.7	15.1	14.6	21.3	16.4	14.6	20.0	18.2
In-migration	[a]	[a]	28.1	26.0	31.2	34.1	23.8	13.4	14.1	23.8
Out-migration	[a]	[a]	29.7	30.7	22.4	35.0	35.1	15.7	41.6	34.2
Natural increase	30.8	28.0	30.7	30.1	29.0	23.2	25.4	33.2	20.1	9.4
Population growth	—	—	29.1	25.4	37.8	22.1	14.1	30.9	−7.4	−1.0
Adjusted crude death[b]	16.9	18.0	17.4	18.3	16.6	23.0	17.3	15.6	24.6	20.8

*Data collected by the Cholera Research Laboratory (CRL), Dacca, Bangladesh.

[a]Migration rates for 1966-67 and 1967-68 are omitted because the definition of migration was changed beginning in 1968-69.

[b]These adjusted crude death rates take into account the lifesaving effects of the CRL diarrheal disease treatment unit in Matlab. The adjustment method used is discussed in footnote 2.

CHART 1.—RANGE OF BIRTH AND DEATH RATES IN MATLAB THANA DURING A BASELINE PERIOD COMPARED WITH QUARTERLY BIRTH AND DEATH RATES AND THE PRICE OF RICE, 1971-76*



*The two pairs of solid lines show the highest and lowest quarterly birth and death rates during five baseline years (1966-67 to 1970-71). The dashed lines show the quarterly birth and death rates (for the last three quarters of 1971 through the first quarter of 1976). Demographic data were collected by the Cholera Reasearch Laboratory. Rice price data are from Government of the People's Republic of Bangladesh, Agro-economic Research Section, Ministry of Agriculture, *Bangladesh Agriculture in Statistics*, Dacca, 1973, p. 113.

Chart 1 was constructed to show the temporal response of births and deaths to the disasters. In the chart the range of the highest and lowest quarterly birth and death rates for five baseline years (1966-67 to 1970-71) was plotted. Superimposed upon these were quarterly vital rates and the wholesale national price of coarse rice for the period 1971-72 to 1975-76. Although there was a marked seasonal swing of baseline values, fluctuations of the quarterly birthrate followed the same pattern as the annual rate. Some nine months after the 1971 conflict the birthrate declined modestly. This was followed in 1973 by an increase, and then beginning in 1974 the rate began a dramatic decline which intensified and extended to the end of the observation period. Fluctuations of the death rate coincided with both crises and gradual recovery was noted after the termination of the disasters.

The fluctuations of vital rates suggest that the impact of the 1974 famine was of longer duration than the effects of the 1971 disaster. Recovery in 1972-73 was far more prompt than in 1975-76. This is consistent with the chronology of the crises. The 1971 war did not affect rural areas until July when the Pakistan army carried military hostilities into the countryside (6). The conflict ended abruptly in December and, although the damage to physical infrastructure was extensive, relief and rehabilitation activities were in full swing by early 1972. The 1974 flooding, however, destroyed the minor and major rice crops in selected areas (8). For many farmers, particularly the landless, the *boro* (winter) rice crop would have provided insufficient food and work opportunities, and normal foodgrain consumption would not have been possible before the next major harvest at the end of 1975.

Regarding the intensities of the disasters, the quarterly birth and death rates appeared to be paradoxical indicators. The birthrate fell farther and stayed down longer after the 1974 famine than in 1971, but the crude death rate did not rise as high. In nutritional impact, the 1974 crisis was more severe than the 1971 disaster. Nutritional surveys in Matlab thana in 1972 and 1975 showed that the percentage of malnourished children after the 1974 crisis was significantly higher than was observed after the 1971 conflict (18). Crude comparison of death rates is, however, misleading because the rate in 1974-76 was artificially reduced by two biases. The provision of health services for diarrheal disease by CRL was more adequate in 1974-76 than during 1971 when the conflict hampered field operations. The adjusted crude death rates given in Table 1 were adjusted on the basis of estimates of the lives saved by the CRL treatment unit.[2] When adjusted, the death rates clearly show a disaster of greater intensity in 1974-75 than in 1971-72. The crude death rate was also depressed in 1974-76 by the marked reduction of births. Fewer births resulted in a lower proportion of infant deaths among all deaths. In 1975-76, for example, the proportion of infant deaths to all deaths was 23 percent in comparison to 35 percent in the three preceding years. Had the crude birthrate in 1975-76 been 45, the crude death rate in 1975-76 would have been 20.8 instead of 18.2 per 1,000. (By coincidence, the estimated effect of this second bias on the death rate in 1975-76 is the same as the effect of the adjustment of the death rate to allow for the effects of the CRL's diarrheal disease treatment services.)

Fluctuations in the price of rice confirm that the two crises were of a different character. Rice prices began their steep rise in 1974 even before the monsoon flooding in July. So too did the onset of the decline of the birthrate which began in the last quarter of 1974. This suggests that conceptions were reduced nine months earlier which was before the onset of the monsoon catastrophe. A likely explanation for this was the marked downturn in the Bangladesh economy which began before the floods. Food scarcity, inflation, and shortages of basic commodities were all noted in early 1974, and crop failure no doubt accelerated this downward trend of the economy (1). The national rice price in 1971, in contrast,

[2] To estimate the probable crude death rate in the absence of diarrheal disease treatment services provided by CRL, the number of hospitalized cases was obtained for each of the study years. Then, assuming that 25 percent of those hospitalized cases would have died in the absence of treatment, the number of total deaths was adjusted upward to obtain the "adjusted crude death rates" for each year that are shown in the bottom row of Table 1.

TABLE 2.—STILLBIRTH RATIO, INFANT MORTALITY RATE, AND AGE-SPECIFIC DEATH RATES IN MATLAB THANA, BANGLADESH, 1966-67 to 1975-76*

Rates	1966-67	1967-68	1968-69	1969-70	1970-71	(War) 1971-72	1972-73	1973-74	(Flooding) 1974-75	1975-76
Stillbirth ratio[a]	33.0	42.6	39.6	35.4	33.2	37.8	39.3	36.1	37.1	40.0
Infant mortality rate[a]	110.7	125.4	123.8	127.5	131.3	146.6	129.2	128.8	167.2	150.4
Neonatal	59.5	67.8	82.9	87.5	89.9	86.9	71.9	81.1	74.8	71.0
Postneonatal	51.2	57.6	40.9	40.0	41.4	59.7	57.3	47.7	92.4	79.4
Death rates[b]										
Ages 1-4	24.9	29.4	23.8	23.1	27.9	25.8	36.9	22.7	29.7	32.7
5-9	4.1	5.0	3.9	3.3	2.3	3.7	11.4	14.1	6.5	12.3
10-14	1.7	2.1	1.7	1.0	1.3	1.6	2.2	2.0	1.6	1.2
15-44	4.1	4.4	3.7	3.8	2.7	3.7	5.1	2.9	4.4	3.8
45-64	15.3	17.9	17.4	17.9	14.4	16.6	20.0	14.7	23.8	25.1
65 over	67.9	79.3	74.4	71.1	72.9	73.1	119.1	96.5	109.3	100.1

*Data collected by the Cholera Research Laboratory, Dacca, Bangladesh.

[a] per thousand live births

[b] per thousand population

failed to exhibit any substantial elevation suggesting that the 1971 famine differed in several major respects. It is likely that the famine was marked more by socioeconomic dislocation due to hostilities than by overall food shortage. Such shortages probably existed in localized areas but may not have affected the nation overall. Moreover, socioeconomic disruption, particularly migration in response to the conflict, could have reduced employment, wages, and purchasing power more than food availability. Under such circumstances, national price statistics for food may not be a reliable indicator of local famine.

IMPACT OF FAMINE DISAGGREGATED

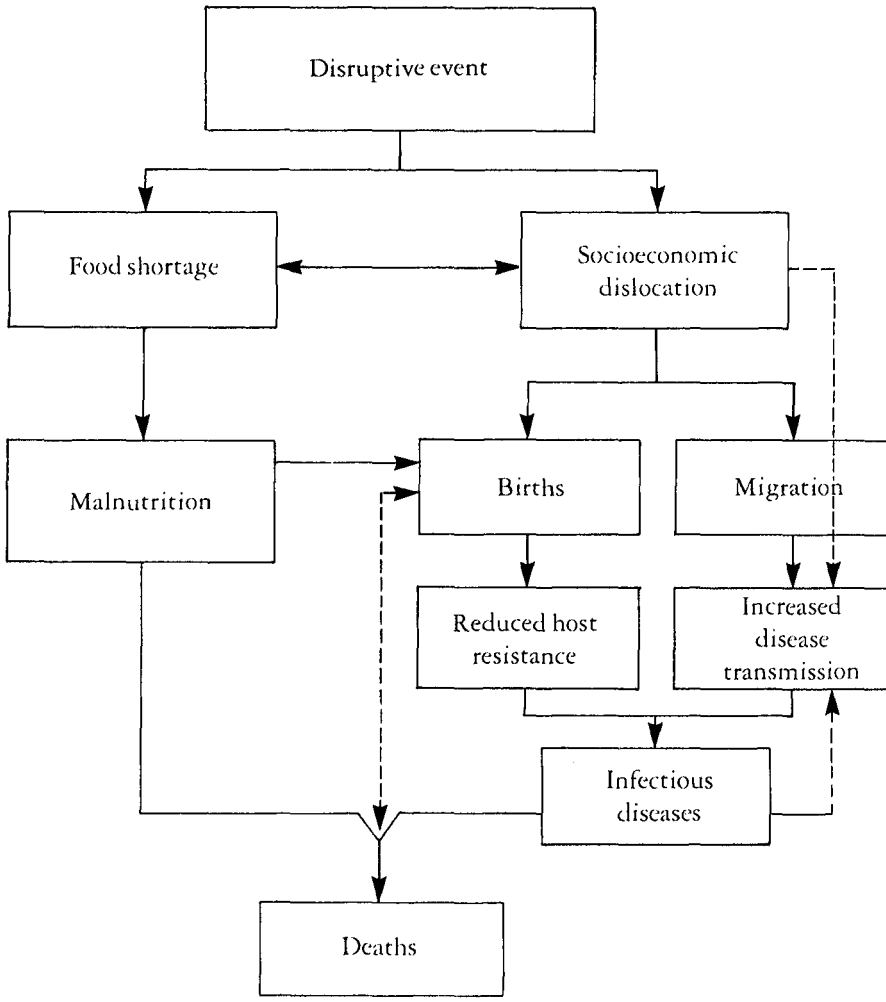
In Table 2 age-specific death rates in Matlab thana for the ten-year period are presented. The mortality burden of the disasters weighed heaviest on the young and the elderly. Infant mortality and the mortality rates among children 1-4 and 5-9 years rose dramatically, as did the death rates of adults over age 45. Noteworthy were the stillbirth ratio and the neonatal (0-29 days) mortality rate which remained unaffected by either crisis. These rates were probably influenced more by long-term biological and maternity care variables than by malnutrition and infection precipitated by an acute crisis.[3] The significant increases of the infant mortality rate were due entirely to postneonatal deaths (30 days-11 months). Interestingly, the infant mortality rate, commonly assumed to be the most reliable indicator of the health status of a community, was only a fair indicator of the crisis. This was due to the preponderant and unchanging contribution of neonatal deaths to infant deaths. The more sensitive age-specific rates were among children 1-4 and 5-9 years. These rates climbed during the crises, and the elevations tended to persist or even increase after the disasters. The persistent elevation of these rates probably reflected an increased incidence of infectious diseases which were exacerbated by the disasters (see below).

Also significant, but not shown in Table 2, were differences in mortality by sex. During baseline years, female mortality consistently exceeded male mortality in all age groups except infant deaths (7). The age-specific sex differentials were more prounouced in children 1-4 and 5-9 years and in the childbearing years. Disaster tended to accentuate these sex differentials among children. In 1971-72 mortality of female children 1-4 years was 57 percent higher than mortality of males in comparison to a differential of 40 percent in the preceding five baseline years. Adult women, however, fared as well as adult men during the crises.

Disaggregating the impact of disasters by demographic characteristics however precise is incomplete because the effects of famine may vary widely between differing socioeconomic groups. It is the poor and the disadvantaged who bear the major brunt of disasters. In one rural area near Matlab thana, for example, the 1975 crude death rate among landless families was threefold that of families with three or more acres of land (13). The differential increased to fivefold among children. The age-specific death rate for children aged 1-4 years, for example, was

[3] Others have reported increases of stillbirths and neonatal deaths during famine; see Smith (20) and Antonov (2). In Bangladesh, no such increases were observed, possibly because many neonatal deaths are due to chronic maternal malnutrition, tetanus, and inadequate perinatal care, variables not altered by acute events.

CHART 2.—POSTULATED INTERACTION OF FOOD SHORTAGE, SOCIOECONOMIC DISLOCATION, AND DEMOGRAPHIC VARIABLES DURING FAMINE



86.5 per 1,000 among landless families in comparison to 17.5 per 1,000 among families with three or more acres of land.[4] Another example was the differing impact of the 1971 conflict on religious groups. The 1971 war probably affected the minority Hindu community disproportionately because the Pakistan army specifically singled out Hindus as a target subgroup (17). The Hindu minority during the 1971 conflict probably experienced higher mortality and lower fertility than their Muslim counterparts, but this cannot be substantiated. It was well documented, however, that the majority of the ten million temporary

[4] During the 1974-75 famine, 83 percent of migrants crowded into camps in transport and urban centers consisted of landless families (1).

migrants from Bangladesh to India were Hindus. This religious minority normally constitutes 15 percent of the Bangladesh population.

THE FAMINE SYNDROME

The two recent disasters in Bangladesh provide essential empirical information for the development of an analytical framework delineating the multiple interacting causes and consequences of famine. The relevant variables and postulated causal links are depicted in Chart 2. A triggering event, such as war or crop failure, may precipitate widespread food shortage by disrupting agricultural production, food distribution, and marketing. Shortages may cause an escalation of food prices which stimulates hoarding, thereby generating a vicious cycle of higher prices and more hoarding. Unemployment may increase from loss of productive employment opportunities (for example, flooding damage to physical infrastructure) or from dislocation of workers (for example, large-scale migration due to war). Unemployment coupled with inflation erodes purchasing power, especially among the poor. Food consumption is reduced. Families trapped in this dilemma may compensate through the sale of assets—such as land, household goods, and farm animals and implements—and may shift to cheaper but sometimes nutritionally inferior foods not customarily consumed.[5] In search of food or work, migration from distressed regions to urban and transport centers may increase, and separation between family members may not be uncommon. Local government may become paralyzed and traditional social and economic relationships may break down. Although an increase of crime and violence has been reported in other disasters, very few such disorders were observed in Bangladesh.

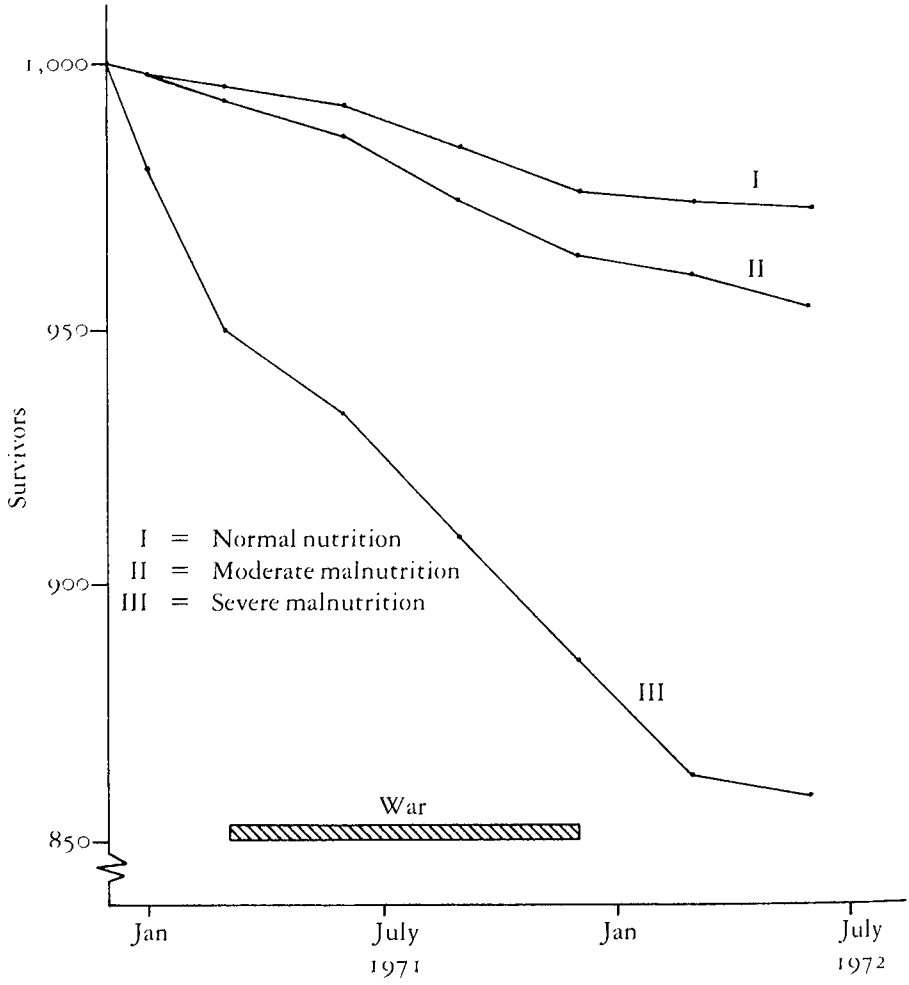
Malnutrition and Infection

The most direct effects of inadequate food supply are undernutrition, malnutrition, and death. This sequence, shown in Chart 2, was well documented in Matlab thana during the 1971 conflict. A predisaster nutrition survey found that the prevalence of moderate and severe malnutrition among children under ten years of age was 41 and 9 percent, respectively (*10*). One year later a post-crisis survey employing the same nutritional standards documented that the prevalence of moderate and severe malnutrition had increased to 54 and 17 percent, respectively. The mortality risk of children during the crisis, moreover, corresponded strongly with nutritional status prior to the conflict. Chart 3 shows the number of survivors followed over a period of 18 months among children 1-4 years according to their nutrition status prior to the crisis (*22*). Of 1,000 children classified as severely malnourished in December 1970, only 860 survived to June 1972 in comparison to 970 survivors among normally nourished children.

The cause of death was rarely starvation per se; rather, infectious diseases usually precipitated the terminal event. In Matlab thana, large epidemics of diarrheal diseases were noted in 1971-73 and 1974-76 (*16*, *11*). Cholera and

[5] Consumption of jute leaves, roots, and other foods not customarily part of a diet may increase. Interestingly, in 1974-75, the price of beef fell below that of rice since on a weight basis beef contains far fewer calories than cereal grain.

CHART 3.—NUMBER OF SURVIVORS AMONG CHILDREN AGES 1-4 YEARS FOLLOWED OVER 18 MONTHS ACCORDING TO PRIOR NUTRITION STATUS, DECEMBER 10 THROUGH MAY 1972*



*Data collected by Cholera Research Laboratory, Dacca, Bangladesh.

shigella dysentery increased markedly but in many cases specific pathogenic organisms could not be identified. In 1971-73 there was evidence of increased mortality due to measles among children 1-4 years and smallpox took a heavy toll, particularly among children under age ten (*17*). There was also a large increase of deaths due to unknown causes, but unlike earlier famines, increased deaths due to tuberculosis, typhus, plague, and influenza were not documented (*12*). Interestingly, deaths due to respiratory infections did not exhibit an appreciable elevation.

Infectious disease and malnutrition acted in unison to greatly affect the death rate. As postulated in Chart 2, these two processes, along with socioeconomic

disruption and demographic change, generated several mutually reinforcing vicious cycles. Socioeconomic dislocation may have enhanced the transmission of infectious diseases through such mechanisms as the breakdown of traditional water sources and waste disposal. Transmission may have been further enhanced by movement of people, particularly large-scale migration of the malnourished, increasing the spread of infectious organisms. Migrants, moreover, tended to congregate at transport centers or in camps leading to overcrowding. This sequence was well illustrated during the 1971 war, when Bangladeshi refugees streamed into India and were settled in temporary camps. Conditions were such that smallpox took hold, festered in the overcrowded camps, and was reintroduced into Bangladesh with the return of the migrants in early 1972 (21). By 1972-73, Bangladesh was in the midst of another major smallpox epidemic. In addition to increased transmission, reduced host resistance due to malnutrition may also enhance the incidence and clinical consequences of infectious diseases. Infectious disease, furthermore, may exacerbate malnutrition by reducing appetite, increasing the malabsorption of nutrients in the gastrointestinal tract, enhancing energy demands, and possibly reducing the efficiency of nutrient utilization (19). An increase of infectious diseases, moreover, may itself further transmission by increasing the number of disease carriers.

Interaction of Demographic Variables

The definition of famine confines itself to mortality, but as shown in Charts 1 and 2, fertility and migration were also profoundly affected by disaster.[6] Moreover, these demographic variables were not mutually independent; rather, the effect of disaster on any one demographic variable represented the net outcome of the crisis on all three parameters. The death rate, for example, has been shown to be a very sensitive indicator of both the intensity and duration of a crisis. Mortality, however, was regulated in part by fertility, since the reduction of births in 1974-76 reduced the proportion of deaths that occurred to infants, thereby deflating the crude death rate. Migration, furthermore, has been postulated to operate as a contributing factor to mortality through the transmission of infectious diseases.

The birthrate, similarly, was affected by deaths and migrations. One year after the 1971 conflict, the birthrate declined. The decline was followed by a rise in 1973 and beginning in 1974 another more dramatic decline was observed. Reduced births one year after the crisis presumably reflected reduced conceptions during the disaster.[7] Famine would be expected to reduce conceptions through behavioral and biological mechanisms. Behaviorally, coital frequency may be

[6] Although the definition of famine quoted earlier refers to "a severe food shortage accompanied by a significant increase in local or regional death rates," Merrill K. Bennett's definition refers to hunger and emaciation as well. "True famine is shortage of total food so extreme and protracted as to result in widespread persisting hunger, notable emaciation in many of the affected population, and a considerable elevation of community death rate attributable at least in part to deaths from starvation" (5, p. 322). Bennett includes the "Bengal Famine" of 1943 among the great famines of history with a death toll exceeding one million. B. M. Bhatia's book, *Famines in India*, describes the Bengal Famine and earlier famines in the Indian subcontinent.

[7] Reduced births could also be the consequence of higher rates of fetal wastage. Fetal wastage rates in Matlab thana however were not affected by the crises.

reduced because of fear, anxiety, or the desire to postpone pregnancy. Induced abortions may increase and the number of couples entering reproductive life may diminish from postponement of marriage (3). An intensification of malnutrition and disease could reduce conceptions prolonging the period of postpartum amenorrhea, increasing the frequency of anovulatory cycles, or increasing fetal wastage.[8] Migration could contribute to reduced conceptions by either voluntary or involuntary separation of spouses.

The post-crisis "compensatory" rise of the birthrate in 1973 was not totally unexpected.[9] Such a rise could be due to either an increase of the proportion of women vulnerable to conception or an increase of the conception rate among these women or both. A post-crisis rise in the proportion of women vulnerable to conception was expected due to the continued vulnerability of women who normally would have conceived during the crisis but had failed to do so; the premature return of ovulation due to the termination of lactation among women who experienced death of young children and the clustering of new marriages that were deferred by the crisis. The conception rate among these women could be higher after disaster because of improved health status or changes in fertility behavior due to attitudinal factors such as the desire to replace lost children (15).

Migration not only may influence fertility and mortality, through the mechanisms postulated earlier, but also may affect the measurement of vital rates. As shown in Table 1, out-migration increased during both crises but in-migration fluctuated paradoxically, increasing in 1971-72 and decreasing in 1974-75. Movement during crisis presumably reflects the net effect of various "push" and "pull" forces (23). Out-migration during the crises probably increased for different reasons. In 1971 many people temporarily migrated to India to escape the hostilities. The 1974 flooding and crop failure affected low-lying riverine areas such as Matlab thana more than high land or urban centers. Rural people, therefore, moved in search of food and work. Migration into Matlab thana increased in 1971-72, probably because hostilities associated with the conflict were more severe in urban centers. Rural areas like Matlab thana constituted a relative haven from danger. Such push forces were absent in 1974. In fact, the major impact of the crop failure was experienced in rural areas, since urban centers were provided with imported foodgrain through ration shops. Not surprisingly, therefore, migration into Matlab thana during 1974-75 decreased.

Migration, it should be emphasized, is invariably selective. Out-migrants from a distressed area would be expected to consist of population subgroups most affected by a crisis. In-migrants would be expected to represent those population subgroups most affected in adjacent rural areas or nearby urban centers. Measurement of births and deaths that are restricted to permanent residents of a single area, therefore, is subject to bias. Subgroups who moved away and are therefore omitted may have been those most likely to experience extreme fluctuations of vital rates.

[8] The role of maternal nutrition in postpartum amenorrhea, anovulatory cycles, and fetal wastage has been postulated by several authors. For a review, see Frisch (9).

[9] Compensatory rises of the birthrate were observed in several historical famines; see Wrigley (24, pp. 62-76).

SUMMARY AND CONCLUSIONS

That famine is a complex syndrome involving multiple interacting variables appears to be well substantiated by this empirical study. Of the three demographic variables, mortality is the most sensitive and consistent indicator of the severity and duration of a crisis. But mortality is influenced by fertility and migration, and mutual interactions between the three are possible. Mortality was the most discriminating index in identifying subgroups of the population at highest risk to the adverse impact of disaster. The young and the elderly were especially vulnerable and, in Bangladesh, young girls were at very high risk. Adult men and women fared better than those at the extremes of life. Disaster also affected disproportionately the poor and the disadvantaged and, depending on the nature of the crisis, other subgroups may also have borne a disproportionate share of the burden.

An understanding of these differentials and the complex mechanism of famine have important implications for disaster intervention programs. Food needs to be channeled to those subgroups in greatest need. Food programs, moreover, should be accompanied by preventive and curative health services to interrupt the vicious cycle of malnutrition, infection, and death. Services delivered directly to distressed areas are likely to be more effective not only in reducing hunger among the most needy but in stemming the tide of migration. Feeding programs at transport or urban centers would provide relief to the destitute but at the cost of encouraging migration and overcrowding. Government policies and programs to stabilize or reduce food prices, minimize hoarding, generate employment, and rehabilitate physical infrastructure would all contribute to recovery.

One major limitation of demographic indicators is that they are responsive to a crisis only after it has already occurred. Earlier warning signals are needed to strengthen disaster preparedness. Ongoing monitoring of climatic change and statistics on agricultural production, surveys of food prices, and surveillance of nutritional status are among the signals that deserve exploration in the development of an effective early warning system. Even more important, of course, is long-term prevention of disasters. Development of infrastructure—such as reforestation, irrigation, drainage, introduction of new crops, and better food storage—would reduce the adverse impact of flooding and crop failure. In the long run, protection against disaster would be strengthened by rural development involving the adoption of new technologies and fundamental socioeconomic change. Such advances, however, would not eliminate man-made disasters such as the 1971 conflict.

One aspect of disaster that deserves emphasis is the fact that crisis exposes and highlights conditions that prevail during normal times. Malnutrition and premature death are all too common in disaster-prone countries like Bangladesh during non-crisis periods. Disaster simply exacerbates the chronic situation, but it attracts more public attention. Another dimension of disaster not customarily considered is the irreversibility of the impact among some victims. Those who die during a catastrophe are obvious examples. Another subgroup is the acutely malnourished who suffer the irreversible effects of malnutrition, such as retarded growth and development and reduced learning. More profound but less obvious irreversible changes may affect the poor and disadvantaged. In a marginal

economy, the disposal of assets may leave many victims without sufficient resources to begin again. The number of landless families may increase and irreversible pauperization may take place. Migrants who move into cities in search of food and work may find themselves with no place to turn to after a disaster and may thus swell the ranks of the unemployed urban poor.

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