HOUSEHOLD VULNERABILITY TO FOOD CRISIS AND MORTALITY IN THE DROUGHT-PRONE AREAS OF NORTHERN ETHIOPIA

MARKOS EZRA* AND GEBRE-EGZIABHER KIROS†

Demographic Training and Research Centre, Addis Ababa University, PO Box 1176, Addis Ababa, Ethiopia and †Population Studies and Training Centre, Brown University, PO Box 1916, Providence, RI 02912, USA

Summary. This study examines the association between a household's degree of vulnerability to food crisis and the incidence of deaths using primary survey data carried out to look at the demographic consequences of drought and famine in the drought-prone areas of northern Ethiopia. Retrospective data on the occurrences of deaths within a household were collected for the period 1984 to 1994. Consistent with previous studies, the findings confirm that mortality was clustered among the age groups 1–4 and 5–9 and varied considerably by famine and non-famine years. Enormous variation in incidence of deaths was also observed by region, ethnicity and religion. Most importantly, the analysis provides substantial evidence that the level of household vulnerability to food crisis is strongly related to the number of hunger-related deaths reported in a household.

Introduction

Current research on the association between household economic status and mortality due to famine crisis is inconclusive. While some researchers (Mesfin, 1986; Asmerom, 1989; de Waal, 1989b) concluded that famine crisis affects all households irrespective of their economic status, others (Webb *et al.*, 1992) have established mortality differentials by socioeconomic status. Using primary data, this study provides evidence on the relationship of household vulnerability to food crisis and the incidence of deaths in a household in communities heavily affected by famine and recurrent droughts in northern Ethiopia. These communities are characterized by poor health and sanitation. The underlying conditions that contribute to famine in Ethiopia are civil war, proneness to climate-driven food production fluctuations, limited asset bases, and low levels of farm technology.

An immense number of studies on the socioeconomic determinants of mortality have been made. Epidemiological researchers often measure the direct association

between inputs to health such as nutrition and medical care, and health outcomes such as child morbidity, disability and mortality. Economic and social researchers, on the other hand, generally evaluate how the constraints on people's opportunities are associated with child health, presumably by affecting some of the direct inputs through behaviour. The general understanding based on such studies is that mortality is strongly related to the economic background of the individual household or community in question.

Population crises characterized by sudden increases in mortality were recurrent features of pre-industrial populations (Palloni, 1990). The epidemiologic and socio-economic causes and consequences of crisis mortality in pre-industrial societies have been studied in the course of explaining the demographic transition framework in a historical perspective. Likewise, several studies have been done on the demographic effects of modern famines such as those in India and China. The effects of famine mortality on population structures, including famine mortality differentials by age, sex and geographic location, have been evaluated by several researchers (Ashton *et al.*, 1984; Watkins & Menken, 1985; Dyson, 1991a, 1991b; Jannetta, 1992). Relative to its demographic and socioeconomic/political significance, however, the relationship between mortality and food crisis or some other natural calamity has not been investigated adequately. Notwithstanding the recurrence of population crises in present-day Africa, for example, accurate predictions of drought and/or famine in the continent on a year-to-year basis are still out of reach because of large random or poorly understood fluctuations of the factors determining them (Bouckaert, 1989). Hence, crisis mortality deserves special attention in the study of human mortality. Although different types of crises exist in Ethiopia, the main focus of this paper is the crisis due to food shortage.

Famine mortality has been a major cause of population crisis throughout history. Studies on famine mortality show that excess mortality is strongly related to the economic background of individual households or communities in question (Sen, 1981; D'Souza & Bhuiya, 1982). Contrary to common belief, however, some researchers argue that famine and other natural disasters that cause huge numbers of human deaths affect all members of a community equally, and that there is no difference between the poor and wealthier households in terms of risks to famine-induced mortality (Asmerom, 1989, 1990; de Waal, 1989a; Mesfin, 1986). In the case of the Ethiopian famine, Asmerom (1989, 1990) studied the 1984–85 famine mortality and estimated the death toll at about 700,000. He argued that there was no difference between poor and wealthy households in terms of risks of famine mortality. His study was based on data collected from resettled communities in Gambela (a region in south–west Ethiopia) where several people from Wello and Tigray provinces were forcefully taken to resettlement sites in the remote areas of the region in 1985–86. These groups of people may not fairly represent the overall population affected by drought and famine, which could have affected the conclusion he made about famine mortality being equally distributed between households, irrespective of their economic status. In addition, the explanatory variables Asmerom considered were limited and could not adequately explain a household's vulnerability to food crisis. Other better indicators of a household's level of vulnerability in the context of the study areas are applied in this analysis.

Unlike Asmerom (1989) and others, Webb, von Braun & Yohannes (1992) argued that there is a significant difference in coping between poor households and relatively wealthier ones. Webb and his colleagues argued that 'while all households in the drought-affected regions studied were affected, the impact of famine varied by household according to income and asset base'. They found that the relatively wealthier households (the top third of households in the sample, with an average annual income of US$ 100 *per capita*) coped better than the poor ones (the bottom third of households, with an annual income of US$ 42 *per capita*). Income distribution also affected consumption, which decreased to one meal or less per day among 63% of the poorest households, compared with only 43% for the wealthier group.

Ethiopia has been affected by famines and droughts since the early 1970s. In demographic terms, the food crisis which affected Ethiopia in 1984–85 was probably the most significant. There was excess mortality, but the exact figure has not been known until now: the minimum estimate is 400,000 (Dessalegne, 1987) and the maximum 1·5 million (Mesfin, 1991). Many authors have put it at around one million, so much so that the figure 'one million' is commonly quoted by the layman. It ought to be noted, though, that most of these figures are based on the reports of journalists or relief distribution agents. Only the work of Asmerom (1990) has applied appropriate demographic techniques to come up with the figure of 700,000. Independent of which estimate represents the actual death toll, there is no disagreement about the severity of this famine. If it were not for relief operations that successfully reduced excess mortality, the figure would have, no doubt, been many times the estimates given in either of these sources.

This paper is based on a large survey done in 1994–95 in the drought- and famine-prone communities of northern Ethiopia. The objective of revisiting the communities was to investigate demographic changes during the 10-year period following their harsh subjection to the 1984–85 famine. Household heads were asked to recall and tell the recording interviewer all deaths that occurred in the household during the last 10 years (1984–85 to 1994–95). Important demographic particulars, including age and sex of the deceased, year of death and causes of death, were collected. Special care was taken to ensure that deaths during the 1984–85 famine were included in the reporting of the household's mortality experience during the last 10 years (Markos Ezra, 1997).

The primary interest of this study was to look at the relationship between the level of household vulnerability to food crisis and incidence of mortality for the period 1984–85 to 1994–95 in communities known to have chronic food shortages. Investigating mortality differentials by the household's vulnerability status is a worthwhile undertaking because focus groups for action programmes intended to alleviate poverty can easily be identified. Likewise, famine mortality differentials by region, to look for differences in the severity of food shortage by localities, was an important aspect of this study. More specifically, the paper intends to answer the following questions: (1) Is the number of deaths observed in a household related to the household's level of vulnerability? (2) Do households with a smaller number of members cope with famine better than households with a larger number of members? (3) Which age groups are most affected by famine mortality? And (4) Do

regional/ethnic and religious differences relate to the observed incidences of mortality in the period 1984–85 to 1994–95?

Households were classified as poor (more vulnerable) or relatively wealthy (less vulnerable), depending on certain socioeconomic variables: household size, education of household head, landholding size, number of livestock, means of ploughing own farmland, and possession of a dwelling unit with a tin roof (corrugated iron roof) (see Table 1 for definition of variables used in the analysis). It is acknowledged that some of the vulnerability measures are available for the survey year rather than for the period prior to the famine. However, it can be safely assumed that wealth status in rural Ethiopia does not change rapidly. Opportunities for fast change in wealth status are highly constrained by the limited resources available to the community. Those who owned oxen at the time of the survey were those who had large numbers of livestock before the famine, while those who had no oxen were those who had either very few or no livestock before the famine. Thus, the wealth status of a family is something that is transferred through generations. For example, most of the tin-roofed dwelling units used to measure level of vulnerability were built before 1984, indicating that these households were the wealthier ones in their communities, even before the famine.

The study area

This study covers communities from the Amhara and Tigray regions of north Ethiopia. Between 1972–73 and 1993–94 the northern regions of Ethiopia, namely Northern Shewa, Wello and Tigray, suffered from famine and a series of droughts that caused their populations considerable distress: hunger and severe nutritional deterioration, massive loss of livestock, depletion of assets and substantial excess mortality were the more obvious manifestations. Distress in these areas was much more severe than in other regions of Ethiopia by any criterion (food deprivation, nutritional damage and excess mortality).

The three regions selected for study were those generally considered to be the most ecologically degraded areas of Ethiopia. In the last three decades, these areas were afflicted by extensive and successive droughts that culminated in the droughts of 1972–73, 1984–85 and 1993–94. The food situation in 1987, for example, was extremely grave and massive imports of wheat, by some accounts equivalent to up to 30% of the total food requirements (Dejene, 1992), prevented the situation becoming even worse. Studies by UNICEF (1990) and the Ethiopian Nutrition Institute (1990) also revealed that nutritional status in these areas is generally below standard. Malnutrition is so severe that it is affecting the normal physical growth of many children. A 1992 World Bank report estimates stunting among children in these communities at more than 60% (World Bank, 1992).

Data, variables and methods

The data used in this study were based on primary data obtained from a survey conducted in Tigray and Amhara, the two Northern Regional States of Ethiopia. The survey was carried out between October 1994 and March 1995 in four *weredas*

Table 1. Description of the independent variables used in this analysis

Variable	Description
Household size	This refers to the number of people living in the same household when the survey was conducted.
Education	This refers to the educational status of the head of the household. It is a dummy variable coded 1 for literate (can read and write) and 0 for illiterate. Illiterate is the reference category.
Type of dwelling unit	This is a dummy variable coded 1 if the household has a house with a tin roof and 0 otherwise. Not having a house with a tin roof is the reference category.
How the household ploughs farm plots	This variable is a categorical one having three levels: using own oxen, using ox pairing with others, and using other means such as using human labour or exchanging labour for oxen or leasing land or other means. Two dummy variables are created with households having two or more oxen being a reference category.
Landholding size	This refers to the total landholding size of the household.
Number of livestock	The survey recorded the number and type of livestock available in the household. An index representing an average number of livestock ownership is formed by giving weights proportional to the average price calculated for the years 1984–94 for the following animals: cows, heifers, young bulls, calves, sheep, goats, horses/mules, camel and donkeys. Oxen are not included in this category.
Migration as a result of famine	This is a dummy variable coded 1 if any member of the household migrated as a result of the 1984–85 famine and 0 otherwise. Did not migrate is the reference category.
Region, ethnicity and religion	Since region, ethnicity and religion interact with each other, a combination of these three variables is used in the model. In Northern Shewa, the sample constitutes households belonging to two ethnic groups (Amhara and Oromo) and two religions (Christians and Muslims). All Oromos in the study area are Muslims. Hence, there are three categories for this region. In Wello, there are two religious groups, but only one ethnic group (the Amhara). Therefore, only two combinations can be made. For Tigray, all households in the sample belonged to the Tigray ethnic group and the Christian religion. Hence, five dummy variables are created with North Shewa–Amhara–Christian as a reference group.

(districts) of the eastern zones of Amhara and four *weredas* of Tigray. The *wereda* is the lowest administrative entity in the political geography of present-day Ethiopia. The survey covered selected village communities (commonly known as Peasant Associations) in the drought- and famine-prone *weredas* of these regions. The objective

of the survey was to investigate the socioeconomic and demographic responses of peasant households to the persisting ecological stress over the last two decades.

Selection of the *weredas* was made on the basis of their experiences of drought and famine in the last two decades as manifested by unpredictable rains, drought, famine, steady decline in agricultural production, shortage of land resources and depletion of forest resources. Archives from the Relief and Rehabilitation Commission (RRC) and a study by Kumar (1990) show that the 1972–73, 1984–85 and 1993–94 famines were very severe in these *weredas*. Present assessments by the government also show that these *weredas* are still suffering from chronic food shortages and that a significant segment of the people in these communities have almost always depended on food aid, even during so-called normal harvest years. Food aid is apparently continuous in these areas, at least in the form of FFW (Food-For-Work) programmes.

Within the *weredas*, village communities that were known to have experienced severe ecological stress and food shortage over the past few decades were selected for the study. All in all, 40 village communities were selected from the eight *weredas*, and from each village community 50 households were randomly chosen for interview. Thus, 2000 households were interviewed in the survey with a structured questionnaire on subjects related to population dynamics, the economic status of households, as well as the dynamics in the composition, structure and formation of rural households. Specifically, data on the occurrences of deaths within a household for the period 1984 to 1994 were collected.

Recall bias can no doubt influence the quality of such data. However, exceptional care was taken to minimize the problem. Questions related to mortality data were designed carefully and interviewers were trained and advised to spend sufficient time to help respondents recall the sequence of events properly. Some very well known events in the community and their sequence of occurrence were used to revitalize the memory of respondents. Moreover, adequate training was given to interviewers and supervisors. In addition, a pilot survey was conducted prior to the main survey, and this helped substantially to improve the nature of questions asked in the survey so that good quality data could be obtained.

Table 1 provides names and definitions of the independent variables used in this analysis. The set of explanatory variables considered in the study included indicators of the household's social and economic characteristics. Among the community-level variables considered were religion and ethnicity. The variables employed to indicate household resource base were: household size, education of the head of the household, how the household ploughs own farmland, number of livestock the household owns, owning a tin-roofed dwelling unit, and whether any member of the household migrated as a result of the 1984–85 famine. Most of the explanatory variables were categorical.

The dependent variable was the number of household members who died between 1984–85 (the year of the Great Ethiopian Famine) and 1993–94 (the survey year). Information regarding mortality was obtained by asking the question: 'Did any member of your household die in the last 10 years?' If the answer to this question was yes, the following questions were asked: (i) when the person died (year of death), (ii) how old the person was when he/she died (age at time of death), and (iii) the cause of death.

Table 2. Distribution of reported deaths by age group and year: northern Ethiopia, 1984–94

| | Year | | | | | | | | | | |
Age	84/85	85/86	86/87	87/88	88/89	89/90	90/91	91/92	92/93	93/94	*n*
<1	5·2	15·0	11·3	15·0	18·2	16·0	9·2	11·0	14·1	13·2	163
1–4	30·7	27·4	35·0	41·7	21·8	43·2	42·3	40·0	37·3	33·8	529
5–9	20·5	15·0	17·5	10·0	14·5	11·1	9·9	11·0	13·4	12·0	230
10–14	9·3	9·7	7·5	1·7	7·3	1·2	7·7	3·4	5·6	4·3	102
15–19	5·6	9·7	6·3	3·3	3·6	6·2	5·6	5·5	4·2	6·4	89
20–24	1·5	1·8	6·3	5·0	3·6	2·5	4·9	4·8	2·8	4·3	49
25–29	3·7	1·8	2·5	1·7	5·5	1·2	2·1	4·8	3·5	3·0	49
30–34	3·1	5·3	1·3	5·0	5·5	2·5	2·8	0·7	1·4	4·3	47
35–39	1·7	0·9	1·3	3·3	1·8	1·2	4·2	2·1	0·7	0·4	25
40–44	1·7	3·5	2·5	1·7	0·0	2·5	0·7	2·1	1·4	2·1	28
45–49	1·2	0·0	0·0	1·7	1·8	1·2	0·0	1·4	1·4	1·3	16
50–54	2·1	0·0	0·0	3·3	7·3	3·7	1·4	2·1	1·4	3·4	34
55–59	2·1	0·0	0·0	0·0	0·0	0·0	0·0	0·0	1·4	0·4	13
60–64	3·5	0·9	1·3	3·3	1·8	2·5	2·8	1·4	2·1	1·7	37
65–69	1·0	2·7	1·3	3·3	3·6	0·0	0·7	2·1	0·0	1·3	20
70–74	3·5	1·8	1·3	0·0	0·0	2·5	1·4	3·4	4·2	3·0	42
75+	3·5	4·4	5·0	0·0	3·6	2·5	4·2	4·1	4·9	5·1	61
Total	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	100·0	
n	482	113	80	60	55	81	142	145	142	234	1534

Descriptive statistics

In Table 2, the number and percentage distribution of reported deaths by 5-year age group and by year of death are presented. Overall, a total of 1555 deaths were reported, of which 21 did not have their ages recorded (not reported by the head of the household). About 10·6% of all deaths occurred to infants while 34% clustered in the age group 1–4. Excess mortality among children aged 1–4 years was also documented in the 1984–85 famine in Darfur, Sudan (de Waal, 1989b). As young children depend on solid foods, children under five could have been the victims of food shortage and infectious diseases (Lawrence, Yimer & Odea, 1992). Children in the age group 5–9 were also observed to be among the most vulnerable. Altogether, mortality of children under 10 years old constituted about 60% of all reported deaths.

Looking at the distribution of deaths by year also gives a more efficient picture of famine mortality differentials by age. Infant mortality during the year 1984–85 appeared to be much less than in subsequent years. This is consistent with the literature, which shows that famine mortality is less severe among infants than children who depend on solid foods (de Waal, 1989b; Lawrence *et al.*, 1992). With regard to child mortality, the proportion of deaths in the age group 1–4 was
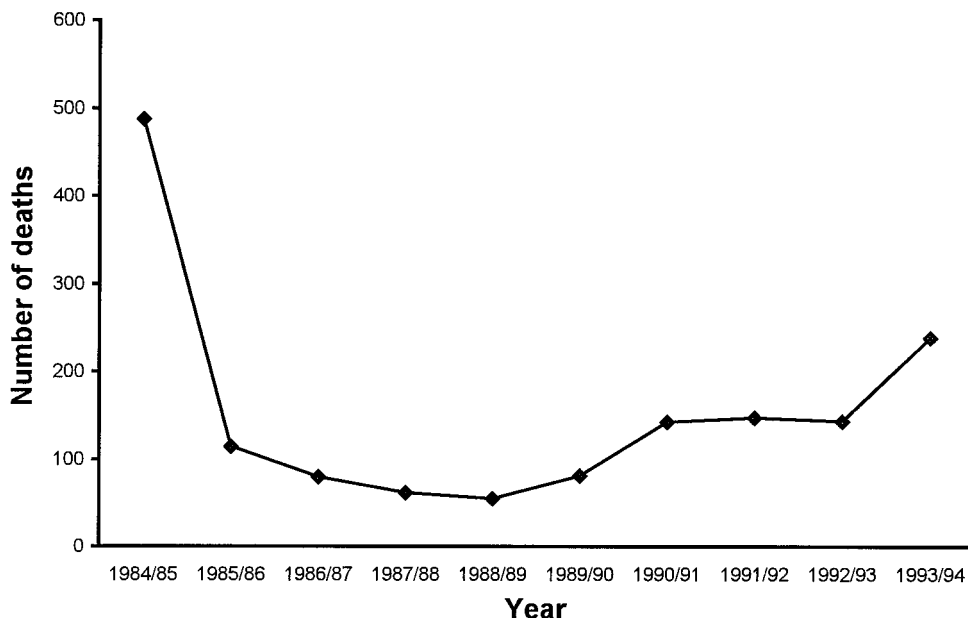
Fig. 1. Reported number of deaths by year: northern Ethiopia, 1984–94.

consistently high for non-famine years while it concentrated on the age groups 1–4 and 5–9 during famine years (1984–85). The most important point that should be made from this is that 482 (31·4%) of all deaths over the 10-year period occurred in 1984–85. And more than 50% of the 482 deaths in 1984–85 were of children in the age groups 1–4 and 5–9.

Figure 1 shows the distribution of reported number of deaths by year of occurrence (1984–85 to 1993–94). As expected, the maximum number of deaths occurred during the year 1984–85, which was the year of the Great Ethiopian Famine. The number of deaths decreased during the period 1985–86 up to 1989–90, and started to increase in the subsequent years of 1990–91 to 1993–94. The increase in the number of deaths in 1993–94 is believed to be related to the serious food crisis that occurred in these communities during that period. An increase in mortality for the period 1993–94 was also observed in the results of the 1994 census (Central Statistical Authority, 1998).

Information about the causes of death as perceived and reported by heads of households was also processed to show people's perception of health hazards in their localities. Based on these reports, 60% of all deaths during the study period (1984–1994) were reported to have been caused by illness while nearly 27% were caused by hunger-related problems as perceived by the local people themselves. The remaining 13% had other causes, including accident, war-related casualties and old age. Of the total number of deaths, only 20 (slightly more than 1%) were reported to be attributable to old age. A closer examination of causes of death by region, as shown in Fig. 2, reveals that many of the deaths that occurred in 1984–85 in Wello
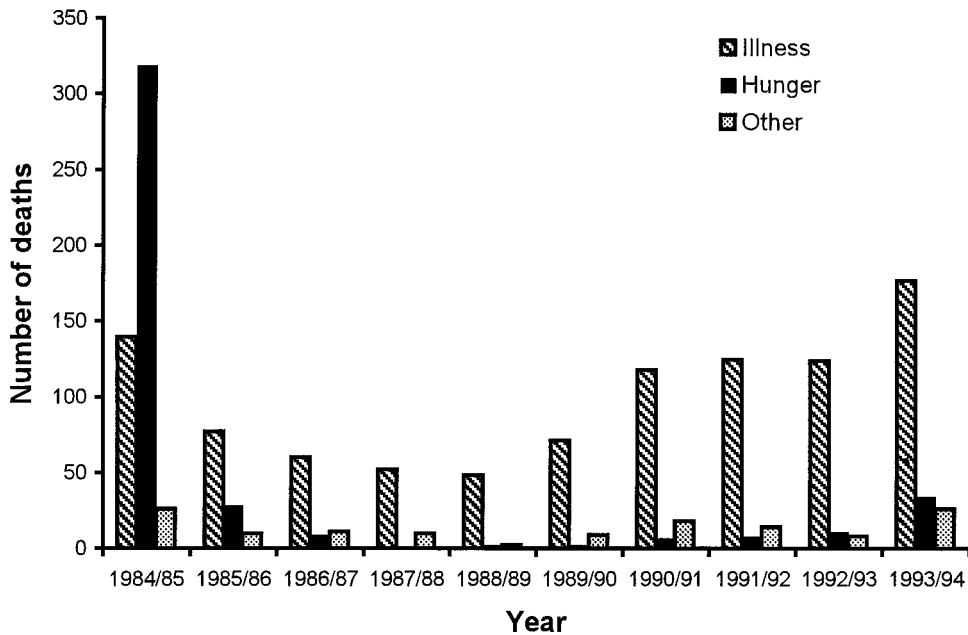
Fig. 2. Reported number of deaths by year and cause: northern Ethiopia, 1984–94.

province were caused by hunger. The communities in Wello were the most affected by the 1984–85 famine.

The types of diseases or health complaints frequently mentioned by the local people included, among others, fever, diarrhoea, vomiting, cough and severe headache. In the survey, 74·3% of the household heads reported that fever was their major health problem (this is presumed to be a symptom of malaria, which is a major problem in many of the communities investigated). Likewise, diarrhoea, severe headache, vomiting, cough and abdominal pain were reported by 36·2%, 65·7%, 41·5%, 38·0% and 29·2%, respectively.

Figure 2 displays the reported number of deaths by year and cause of death. The category 'other' includes all other causes of death except those attributed to illness or hunger. The figure clearly reveals a tremendous variation in cause of death by year. As expected, respondents attributed many deaths in 1984–85 to hunger. However, except for the year 1984–85, the leading cause of death was illness. As clearly displayed in the Figure, the number of deaths caused by illness increased after the year 1988–89.

The reported number of deaths by year and region is presented in Fig. 3. An interesting pattern in mortality is observed in these communities. In the year 1984–85, the highest number of deaths was observed in Wello followed by Northern Shewa, which again suggests the severity of the 1984–85 famine in Wello. After the year 1986–87, a higher number of deaths was observed in North Shewa than in Wello or Tigray. The year 1993–94 also exhibited higher survival disadvantage in all the communities.
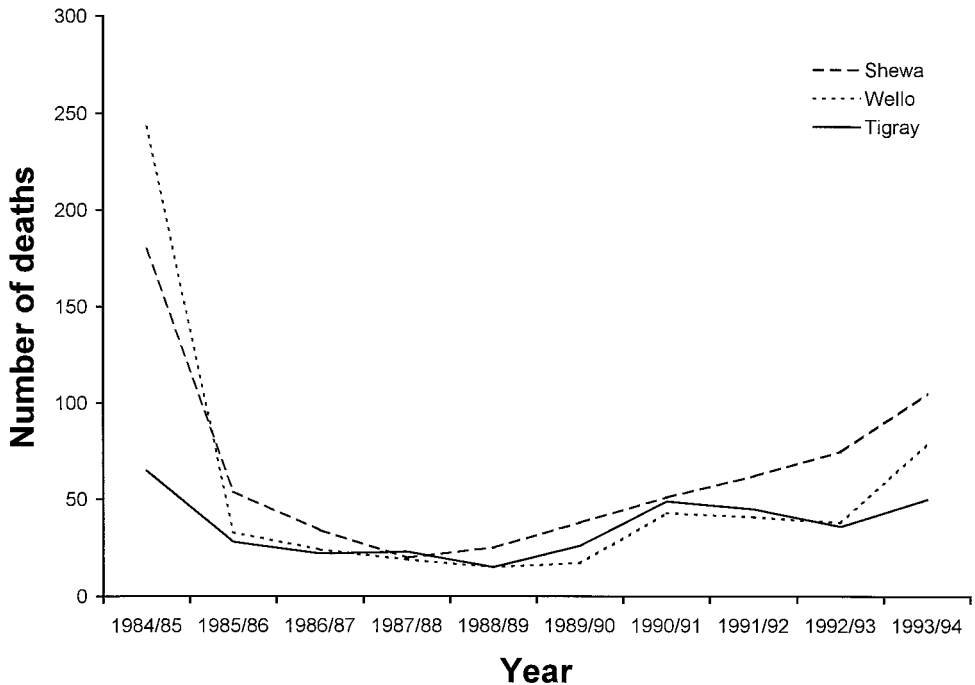
Fig. 3. Reported number of deaths by year and region: northern Ethiopia, 1984–94.

Multivariate analysis

Ordinary least-squares regression was used to model the effect of explanatory variables when the dependent variable was normally distributed. In this case, the number of deaths observed in a household within the 10-year period range from none to five. Hence, to investigate whether level of household vulnerability and other factors affect the number of deaths in a household, a Poisson regression model was applied. Since the dependent variable was the number of deaths observed in a household that is discrete, Poisson regression was more appropriate than an ordinary least-squares regression model.

The number of occurrences of death in the ith household was estimated using:

$$D_j = E_j \exp\ (\beta_0 + \beta_1\ x_1 + \beta_2\ x_2 + \ldots + \beta_k\ x_k),$$

where D_j is the number of deaths that occurred in the jth household,

E_j is the expected number of deaths,

β_js are the underlying Poisson coefficients,

x_js are household characteristics.

Three Poisson regression models were fitted. In the first model, the dependent variable included all deaths that occurred in the household during the study period regardless of cause of death. In the second model, only the number of deaths reported to be caused by illness was considered. In the third regression model, the analysis was restricted to deaths that were reported as being due to hunger.

Table 3. Parameter estimates of Poisson regression models of incidence of deaths: northern Ethiopia, 1984–94

Variables	Model 1 All deaths	Model 2 Deaths due to illness	Model 3 Deaths due to hunger
Household size	0·043 (0·012)***	0·022 (0·015)	0·110 (0·023)***
Head of household			
has some education	− 0·104 (0·060)*	− 0·015 (0·073)	− 0·432 (0·134)***
House has tin roof	− 0·165 (0·078)**	− 0·156 (0·097)*	− 0·262 (0·160)*
Means of ploughing			
Pairing with others	0·039 (0·061)	− 0·007 (0·076)	0·231 (0·124)*
Using other means	0·043 (0·075)	− 0·072 (0·096)	0·278 (0·142)**
Landholding size	− 0·015 (0·030)	− 0·024 (0·039)	− 0·079 (0·061)
Number of livestock	0·008 (0·007)	0·008 (0·009)	0·013 (0·014)
Migration due to famine	0·186 (0·061)***	0·070 (0·078)	0·425 (0·111)***
Region, ethnicity and religion			
North Shewa–Amhara–Muslim	0·529 (0·098)***	0·284 (0·116)**	1·432 (0·246)***
North Shewa–Oromo–Muslim	0·404 (0·102)***	− 0·405 (0·102)***	1·353 (0·201)***
Wello–Amhara–Christian	− 0·060 (0·125)	− 0·696 (0·169)***	1·310 (0·271)***
Wello–Amhara–Muslim	0·102 (0·090)	− 0·372 (0·110)***	1·317 (0·163)***
Tigray–Christian	− 0·378 (0·090)***	0·089 (0·126)	− 0·354 (0·265)
Constant	− 0·548 (0·117)***	− 0·565 (0·284)***	− 3·175 (0·140)***
Model chi-square	211·09***	91·64***	282·05***
Degrees of freedom	13	13	13
Number of cases	2000	2000	2000

*$p < 0.10$, **$p < 0.05$, ***$p < 0.01$; standard errors are in parentheses.

Results and discussion

Table 3 presents the results of three Poisson regression models. In all models, the chi-squared value is highly significant, which suggests that the number of deaths follows a Poisson distribution and that there is an association between the number of deaths observed in the household and variables indicating household vulnerability to food crises, as well as other variables. A substantial increase in goodness of model fit was also obtained when deaths that were reported to have been caused by hunger were considered.

As expected, an increase in household size was positively related to the rate of incidence of deaths in a household, in all models. In addition, the effect of household size became stronger when only deaths caused by hunger were considered. There are various explanations for this phenomenon, but the most plausible one is the diminishing *per capita* share of household resources. In times of food scarcity, households with larger numbers of members are the ones that are affected most severely (Lipton, 1983). A crowd with few resources to share is obviously the group that is easily affected during a crisis. Many studies (Chen & Chowdhury, 1977;

Sen, 1981; D'Souza & Bhuiya, 1982; Schultz, 1985; DaVanzo, 1988; Lipton, 1983) have shown that mortality of children is strongly related to the household's demographic as well as economic characteristics, including its size. The argument is that an increase in the number of children reduces the *per capita* attention children receive from their parents. This is even worse under conditions of food insecurity stress, such as in the communities under investigation.

These results strongly suggest that education of the head of the household considerably decreases the occurrence of deaths. As shown in the models, education plays an important role in explaining crisis mortality. The negative effect of education is much stronger in Model 3, where only deaths due to hunger are considered. The differential in mortality by level of literacy is partly explained by the fact that people who participate in formal schooling, the literacy campaign programmes and other adult education programmes, have not only enabled themselves to read and write, but have gained invaluable sanitation and health-related lessons which have considerable impacts on the health status of their children. Household heads who are literate or have a higher level of education have a better understanding of crises, and better coping strategies. Similar results were observed in the Sudan (Tesfaye, Von Braun & Zaki, 1991) during the 1985 famine.

The majority of houses or dwelling units in rural Ethiopia are primarily constructed of wood, grass and mud. Ownership of a tin-roofed house in rural Ethiopia is a symbol of prestige and an indication of wealth. But more importantly, it is a symbol of exposure to market-oriented economic sources. This study has established that households who own tin-roofed dwelling units are those that have access to market-oriented economic sources, either through remittances or through their own involvement in cash crop production. These are the less vulnerable households in the context of the communities under investigation. Interestingly, the analysis shows that having a dwelling unit with a tin roof is negatively related to occurrence of famine deaths. Number of famine deaths tends to be less in households that own a dwelling unit with a tin roof.

In Ethiopia, how the household ploughs its farmland is an important indicator of the level of household vulnerability to food deficit. Farmers lacking farm oxen are generally considered to be poor. In this analysis, a household's means of ploughing is found to be weakly associated when considering all deaths and deaths caused by illness. However, the incidence of deaths is found to be significantly higher in households that have only one ox or no ox at all compared with households with at least a pair of oxen, when considering only deaths reported to be due to hunger. More interestingly, the incidence of deaths is higher by 26% (exp(0·231)) and 32% (exp(0·278)) in households with only one ox and no ox at all, respectively. In general, livestock possession in rural communities of Ethiopia is an indicator of poverty status (Dessalegne, 1992). Number of livestock excluding farm oxen was included in the model but did not represent strong association with incidences of famine deaths.

The core of the village economy is the cultivation of cereal crops of different varieties and cycle lengths. Some of the crop varieties require intensive land ploughing and preparation before sowing the seeds. Sowing has to be done at the right time when the rains come because rainfall is erratic and scanty. These circumstances

necessitate an all-time readiness on the part of farmers in order to optimize the exploitation of the scarce climatic resources at their disposal. This implies that households that do not own oxen cannot plough their lands intensively and at the right time. Those who are lucky enough to get oxen in exchange for their labour have to wait until the households who possess oxen finish ploughing their own lands. This means that oxen-less households cannot plough their farms several times and sow them at appropriate times (which are rare opportunities in areas where rainfall is unpredictable and short), and this is a major factor in reducing farm outputs. Those who lease out their lands with a crop-sharing arrangement are obviously at a great disadvantage.

Whether migration of any member of the household due to famine or drought is associated with the number of deaths was also considered. Migration due to famine or drought may indicate the extent of household vulnerability because there is evidence that the very vulnerable households migrated to feeding camps or urban centres. These results suggest the existence of an association between number of deaths and migration of household members due to food crisis.

Region, ethnicity and religion are strongly related with the number of occurrences of deaths. Since these three variables are inter-related among themselves, to see the net impact of each variable controlling for others, five dummy variables were created. Respondents from Northern Shewa and Amhara ethnic groups who were Christians constituted the reference category. The findings suggest a strong and significant relationship between region, ethnicity and religion on the one hand and reported number of deaths in a household on the other. Significantly more deaths occurred among Amhara Muslims in Northern Shewa compared with Amhara Christians. The explanation for this is that the villages where the Amhara Muslims are located (villages west of Senbetei town) are known for their mortality risk, even during non-famine years. Although a relatively small number of deaths were observed among Amhara Christians in Wello compared with Amhara Christians in Northern Shewa, the incidence of deaths due to hunger was significantly higher among the Amhara Christians in Wello. As explained earlier, the intensity of famine mortality was also higher in Wello. The incidence of mortality in Tigary was found to be lower than Northern Shewa and Wello.

Conclusion

Environmental degradation is one of the most critical ecological upheavals in Ethiopia which continues to affect large masses of land areas and leaves huge numbers of people vulnerable to food crisis. People living in these critically degraded areas have been exposed to malnutrition and epidemic diseases, which often flare up during times of drought. Micronutrient deficiency diseases have become rampant in these populations. Mortality in these communities has been considerably higher than in other areas where there is security of food supply and stability of climatic conditions. In Ethiopia, particularly in the north, the 1984–85 famine was extremely severe and consequently every possible kind of damage occurred to an alarming degree: hunger and severe nutritional deterioration, massive loss of livestock, depletion of assets and substantial excess mortality.

In this study the association between a household's level of vulnerability to food crisis and the incidence of deaths was examined using primary data. Occurrence of deaths by cause was examined during famine and non-famine years. Consistent with previous research on famine mortality, the results confirm that mortality was excessively high among children in the age groups 1–4 and 5–9. In addition, mortality was found to be much higher during famine years. These findings provide evidence that the incidence of death was higher in more vulnerable-to-food-crisis households than in households whose wealth status was relatively better. Moreover, the results strongly suggest that vulnerable households suffered more deaths due to hunger.

Enormous mortality differentials by region, ethnicity and religion were also observed in the communities under investigation. These observed variations are attributed to differences in ecological variation, as well as differences in the intensity of the crisis in these communities. In addition, coping strategies to overcome famine crisis varies by ethnicity, region and religion. For example, mortality for all non-famine years was higher among the Christian Amharas living in the lowland villages of Northern Shewa than their Christian Amhara counterparts in Wello. The lowland areas embrace lands that are less than 1500 m above sea level, with high temperatures, low vegetation density and a susceptibility to health hazards such as malaria.

Acknowledgments

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