Reading

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Shah, B. V. (1983). Is the environment becoming more hazardous? - A global survey 1947 to 1980. Disasters: The Journal of Disaster Studies and Management, 1(3), 202-209.

Is the environment becoming more hazardous? — A global survey 1947 to 1980

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This paper examines the assertion that natural disasters are increasingly destructive using evidence from disaster reports during the period 1947—1980. The criteria for judging the impact of a given natural disaster are chiefly loss of life and the extent of the geographical area affected. In spite of uneveness and bias in the reporting of sudden impact disasters the conclusions are that both the frequency of disasters and number of people killed are increasing. Further research into the social consequences of disasters and the need for disaster preparedness training programmes are recommended.

Key words: Sudden impact disasters; Floods; Mortality; Morbidity; Population growth; Pre-disaster planning.

INTRODUCTION

It is a widely held view among workers in the field of disaster research that, while the number of natural disasters is decreasing, the area which these disasters encompass and the resultant social impact appears to be increasing. Newspaper reports of natural events seem to echo the same view. The magnitude of the impact of natural disasters in recent years is manifested in the statistics: more than 200,000 people died in the cyclone and flooding of Bangladesh during 1970; the 1972 earthquake in Managua, Nicaragua killed 10,000 persons; hurricane Fifi took nearly 4,000 lives in Honduras in 1974. In 1976 a particularly high incidence of natural disasters, especially seismic events, were experienced. In February of that year 23,000 people were killed in Guatemala, while the Tangshan earthquake in July earned the infamous title of being the world's worst disaster event, when 240,000 people were killed in the People's Republic of China. In 1979 hurricanes David and Frederick caused greater than $3 billion damage in the U.S.

Statistics such as these have been used to support the proposition that the frequency, severity and consequences of major natural disasters appear to be increasing. It is a paradox, that in our technological age, with an enlarged capacity to manipulate nature, man's vulnerability to injury from natural hazards seems to be increasing. This phenomenon could be partly explained by factors such as over-population, unplanned urban and rural growth, or detrimental agricultural practices, all of which distort the complex interaction between physical and human systems, thus increasing man's susceptibility to damage from the occurrence and uncertainty of extreme events in nature. However, "in addition to the 'real' increase in the impact from natural hazards," there seems to be "an 'apparent' increase due to improved communications" disseminating information about latest catastrophes rapidly to greater parts of the world, thus creating a growing awareness and consequently intolerance of the capricious behaviour of nature (Burton *et al.*, 1968).

The purpose of this paper is to investigate the hypothesis that the frequency of large area disasters and number of deaths are increasing, as observed by Dworkin (1974). The main aim of this study is to up-date and re-evaluate Sheehan and Hewitt's (1969) and Dworkin's (1974) work, the methodology being of primary concern in the analysis. An attempt is also made to comment on the implications which the research findings provide, for the effectiveness and/or need for disaster prevention and preparedness programmes.

BACKGROUND

The initial attempt to compile an inventory of the type, recurrence, location and impact of all forms of major natural disaster led to the publication of the paper entitled "A pilot Survey of Global Natural Disasters of the Past Twenty Years" (Sheehan and Hewitt, 1969).

The information was collected for the 21 years 1947 to 1967. A major disaster was defined as one which satisfied at least one of the following operational conditions:

- At least $1,000,000 damage
- At least 100 persons dead
- At least 100 persons injured.

The data were compiled from:

- *New York Times Index* (with reference to original reports where necessary)
- *Encyclopedia Britannica Year Book*
- *Collier's Encyclopedia Yearbook*
- *The American people's Encyclopedia Yearbook*
- *Keesing's Contemporary Archives*
- Miscellaneous collections of data on particular hazards which were generally used as checks.

*This paper is a modified version of an undergraduate thesis submitted to the Dept. of Geography, London School of Economics.

Sheehan and Hewitt considered the following 19 natural disasters, the groupings following the typology of press reports: floods; typhoons, hurricanes, cyclones; earthquakes; tornadoes; thunderstorms; snowstorms; heatwaves; coldwaves; volcanoes; landslides; rainstorm; avalanches; tidal waves; fog; sand and dust storms. Droughts were not included in the analysis due to problems in defining the beginning and the end of a drought. For instance the Sahelian drought which is said to have occurred for the period 1968 to 1974, was not a sudden phenomenon. It was preceded by a prolonged downward trend in rainfall for about a decade, leading to progressive desiccation of the landscape and increasing stress on all resources. Also the long duration of droughts relative to the 'memory' of reporting media make it difficult to distinguish between droughts and differentiate the areal boundaries over which droughts occur. Moreover, estimates of the social impact of droughts are usually inaccurate, drought often only being an indirect cause of death. Droughts lead to a decrease in the resource base, reducing agricultural productivity and causing widespread nutritional deficiency which may be the eventual cause of death.

In this initial attempt, Sheehan and Hewitt found great variability in details of disasters between the sources, thus making any generalizations inconclusive. However, they did observe that the number of major disasters due to floods represented by far the greatest due to any single natural agent. The expected large differences in loss of life between the industrialized western nations and others was also evident.

This pilot study on the analysis of major disaster statistics was up-dated by Dworkin (1974) in the paper entitled "Global Trends in Natural Disasters 1947—1973." This paper's methodology was consistent with that used in the Sheehan and Hewitt paper so that trends observed from 1947 to 1967 could be followed easily.

Dworkin's work confirmed the observations made in the previous study. The number of major disasters due to floods continued to be the greatest. But in general, the number of major disasters were decreasing, while the area which these disasters encompassed and the deaths which occurred had been increasing. The discrepancy in deaths between industrialized (high income) and other (low to moderate income) countries still existed, though high death rates were also a function of geological condition and coastal location.

EVALUATION OF DATA AND METHODOLOGY

Both the studies rely on news reports as their main source of data. This introduces a cultural and professional bias in reportage of numbers as well as details of disasters. During the course of the present study it became obvious that big disasters are news, but that not all disasters have similar news value. To warrant a mention, disasters in developing countries must be characterized by large numbers of dead or homeless, while a flood or hurricane in the U.S., leading to a few injured though excessive capital damage, is guaranteed a place in the national newspapers. Reports are often exaggerated and, though this is not always deliberate, may result from misperception of the situation. While reporters are trained professionals, they are also subject to human emotions, reacting to the destruction and suffering around them. Lack of experience in an unfamiliar culture and environment may lead to a distorted report on the social impact of a disaster.

The particular data source used in the two studies introduces another limitation to the analysis. The sources provide a strong American bias in the data. There is a more complete reportage of disasters in the U.S. over the whole spectrum, with much of Africa, Europe, China and U.S.S.R. likely to be under-represented or unrepresented. Though communication patterns have improved markedly in much of the world, disasters occurring in U.S.S.R. are rarely reported in the West, and if reported, often only the incidence of a disaster is noted while death and destruction is unknown. Reporting on China had decreased since the early fifties, but since ties with the West were re-established, more information on disasters is becoming available. Europe is under-represented because many disasters are not on a scale which have sufficient news-value. The deficiency in information on African natural disasters seems to be for two reasons: many countries lack the infrastructure to carry out comprehensive reportage of disasters and, in much of northern and eastern Africa drought is the dominant natural hazard which was excluded in the two studies.

The choice of hazards may also contribute to the incomplete global picture. The type of natural agents considered in both papers show a northern hemisphere bias, where snowstorms, cold waves, rainstorms, avalanches, fog and frost are perceived as hazards more so than in other parts of the world. For a natural agent to be designated as a hazard depends on the definition used, for what is catastrophic for one system may be viewed as non-deleterious, even as advantageous for another. For example, a threshold of crippling snowfall for London is lower than the threshold for New York. There are no strictly physical definitions of what levels of severity of natural events constitute hazards. "A particular level of severity of a natural event becomes a hazard only in relation to existing human adjustments," the social impact of hazards being a "measure of the relative success of these adjustments to variable nature" (Russel, 1970). The success of human adjustment is a function of individual perception of a hazard, private adjustment to it, and the prevailing social view of losses suffered. Time is another variable to be considered, so that we may say that a severe storm may cause a great amount of damage in a particular human setting at a particular point in time. But once that setting is allowed to vary, due to past adjustments, the same social impact will not be achieved from a storm of the same severity. Thus, hazards are a cultural phenomena, defined by prevailing thresholds of tolerance, standards of living, expectations, perceptions of environment and technologies.

Further limitations to the analysis are imposed by the criteria used to define a major natural disaster, which are necessarily arbitrary. The stipulation of minimum capital damage of $1,000,000 has a strong cultural bias. Many natural disasters are included for North America, especially at the smaller end of the spectrum in which deaths are low

or absent, by virtue of higher property damage. However, the same relative intensity disaster would not be included in reporting elsewhere, where property damage may be insignificant and the magnitude of any disaster which occurs will be measured largely in terms of deaths. Higher capital damage in North America reflects the higher property and real-estate values there, but also the existence of widespread insurance against natural hazards. In developing countries there often exist few means of assessing monetary value of damage, especially where property or crops have not been insured. Thus, an inadequate picture of the social impact of hazards is formed.

The conditions of at least 100 persons dead or 100 persons injured, defining the human impact of a major disaster, are also obviously crude. Often a disaster was excluded where 99 people died, while one that resulted in 100 persons injured was included, as observed by Dworkin. Perhaps one reason for adopting these criteria is rooted in the fact that the two studies relied on news reports as it main source of data. It is big disasters, with large numbers of dead or injured, with excessive amount of capital damages, that make the news. It may also be due to the fact that, most often, estimates of dead or injured are stated in round figures such as 100.

Another problem with the use of arbitrary definitions of major disasters is that it assumes the costs of hazards and resources of individual countries to be the same the world over. It is meaningless to make simple comparisons of figures of dead or damage between countries. The social impact of natural disasters has to be viewed in its national context. For example, the impact of 33,000 homeless in South Korea is far greater than one million displaced in monsoon floods in India; South Korea is a much smaller country in terms of population numbers. When considering capital costs of disasters, they must be expressed as an index relative to the resources of a country. For example, in 1980 damage from floods cost $2.46 per capita, but was only 0.02% of the GNP of the U.S. While for Bangladesh, though floods only caused $1.73 per capita damage costs amounted to 1.9% of that country's GNP.

It is with such considerations in mind that the present study has been conducted.

METHODOLOGY

The object of this study has been to up-date previous work done on the analysis of disaster statistics of dead, injured and dollar loss. Thus, the main problem was to overcome the limitations already discussed while at the same time maintaining some sort of consistency so that the trends could be easily followed. This would have entailed locating and re-examining the data for the period 1947 to 1973 and up-dating the trends to 1980. However, these intentions were thwarted by the unavailability of adequate data for most parts of the world, except the U.S. and the need for a complete re-examination of primary data which was outside the scope of this study. Despite its limitations, this paper therefore largely follows the methodology of the previous studies.

The same 19 natural hazards are considered here: floods; typhoons; hurricanes; cyclones; earthquakes; tornadoes; thunderstorms; snowstorms; heatwaves; coldwaves; volcanoes; landslides; rainstorms; avalanches; tidal waves; fog; frost; sand and dust storms.

An attempt was made to use the sources of data employed in the previous studies. However, the *Collier's Encyclopedia Yearbook* and the *American People's Encyclopedia Yearbook* are not available in the U.K. As additional data sources, UNDRO News and data from USAID Disaster Assistance Office was utilized in the hope that some of the American bias in other data sources would be removed.

Thus the data was compiled from:

- *New York Times Index* (with reference to original reports where necessary)
- *Encyclopedia Britannica Yearbook*
- *Keesing's Contemporary Archives*
- Miscellaneous collection of data such as UNDRO News, Earthquakes Information Bulletin, USAID Disaster Assistance Office.

A major disaster was defined as one which satisfied at least one of the following operational conditions:

- At least $3,600,000 damage
- At least 100 persons dead
- At least 100 persons injured.

It was necessary to revise the condition of minimum capital damage of $1,000,000 as used in the previous studies, in order to take account of inflation and price rises. A comparable figure was deemed to be $3,600,000, calculated from the money index in the International *Financial Statistics Yearbook* of 1981.

LIMITATIONS TO METHODOLOGY

The use of data sources, other than newspaper reports, did not eliminate the North American bias completely.

During the course of this study it became apparent that, while the number and incidence of major natural disasters was consistent between sources, details of death and destruction varied widely. Thus, an educated guess had to be taken as to what were reasonable figures for the social impact of a disaster.

SUMMARY OF FINDINGS

This paper up-dated Sheehan and Hewitt's and Dworkin's studies and investigated whether the trends have continued throughout the 1970s. Table 1 enumerates all disasters and large area disasters for the period 1947 to 1980. The unit of analysis was in terms of 10° square units (latitude by longitude). Figure 1 illustrates 5-year moving averages for all disasters and large area disasters.

Five-year moving averages for death per million population are also indicated in Figure 1. These averages were calculated by dividing the total number of dead for each year by the 1973 world population figure. The use of the 1973 figure as the denominator in the calculation hides the true size of deaths per million population. For the years

Table 1. All disasters and large area disasters 1947—1980

Year	All disasters	Large area disasters
1947	30	3
1948	45	3
1949	31	2
1950	35	3
1951	33	4
1952	28	9
1953	45	5
1954	35	4
1955	33	3
1956	28	6
1957	34	2
1958	25	6
1959	31	10
1960	34	9
1961	25	4
1962	24	1
1963	32	4
1964	28	8
1965	26	7
1966	29	3
1967	30	2
1968	38	10
1969	25	8
1970	24	8
1971	26	5
1972	33	9
1973	29	10
1974	29	4
1975	23	2
1976	36	5
1977	36	4
1978	33	2
1979	39	5
1980	38	6

preceding 1973 the methodology leads to an underestimation, while the averages for the years succeeding 1973 have been overestimated. To provide a more accurate representation of the data, a relative comparison of total number of deaths in each year with the world population in that year must be made. In the present study, the situation could not be rectified since Dworkin does not list the total number of deaths in each year from 1947 to 1973, which would have permitted a recalculation of the averages.

Figure 1, which illustrates the trends produced by this survey, shows that the observations made by Dworkin have not all been confirmed. The number of all disasters has been increasing since 1976, after an approximately 20 year low period. At the same time the number of large area disasters has been decreasing. Generally, the pattern of large area disasters follows a cyclical path with each period of oscillation spanning approximately 14 years. However, the trend of increasing number of deaths, as observed by Dworkin, has continued, corresponding to higher frequency of large area disasters in the past and the increase in number of all disasters in recent years.

The number of major disasters due to floods continued to be the greatest, accounting for 31% of all disasters (Table 2). A further 20% were due to typhoons, hurricanes and cyclones and 17% due to earthquakes. This latter figure may be overestimated because the variables defining an earthquake disaster are more easily isolated and detected.

An examination of Table 3 reveals that, while floods made the greatest contribution to the number of major disasters, only 16% of all deaths were due to this natural agent. Typhoons, hurricanes and cyclones together accounted for 40% of all deaths and 37% were attributed to the earthquake hazard.

Figure 2 shows deaths per million population for individual countries. There exists considerable variation between countries in the same continents. Those countries characterized by the highest death tolls are located in unstable geologic areas or in the zones of frequent frontal interaction. A comparison between Figs. 2 and 3 reveals a correlation between GNP per capita and death tolls. Many of the industrialized, high income countries, experience low death tolls from major disasters, the only exception being Japan. The low to middle income countries, and those located in disaster prone regions suffer the greatest social impact. Figure 2 also reveals the lack of information for much of Africa and the Soviet Union.

Table 4 exposes a strong regional pattern in loss of life from major disasters. Asia, which contains mainly developing countries with large populations and low levels of per capita income, is characterized by high values for death per disaster impact. The continents of Africa, South and Central America occupy an intermediate position.

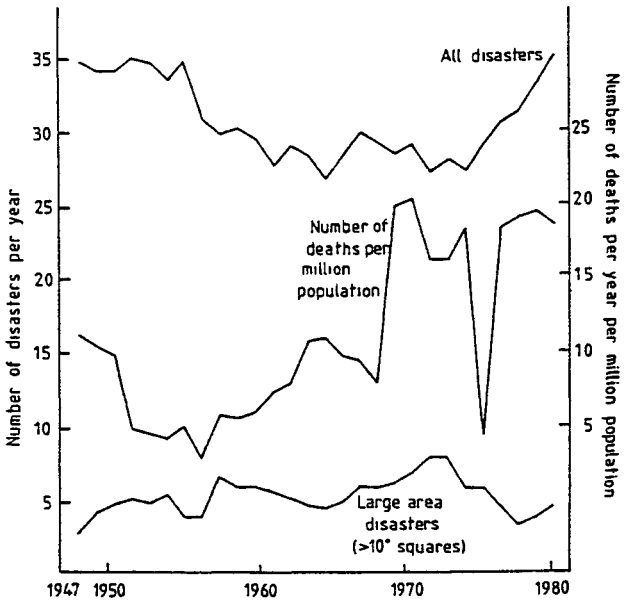

Fig. 1. Global disasters 1947—1980, 5-year moving average.

Table 2. Number of disasters by natural agent 1947—1980

Agent	Number of disasters
Floods	333
Typhoons, hurricanes, cyclones	210
Earthquakes	180
Tornadoes	119
Thunderstorms	37
Snowstorms	32
Heatwaves	25
Coldwaves	14
Volcanoes	18
Landslides	33
Rainstorms	33
Avalanches	12
Tidal waves	7
Fog	3
Frost	2
Sand and dust storms	3
Total	1,061

Europe and Oceania are represented on the lower end of the scale, while North America experiences the least human impact from major disasters. The extremely low figure of 32 deaths per disaster impact for North America, reflects the more complete reportage of disasters at the smaller end of the spectrum in which deaths are few or absent. Also, more disasters qualified for inclusion as major disasters by virtue of higher property damage.

DISCUSSION

Two points may be concluded from this study: the number of disasters is increasing and high death tolls are still a characteristic of less developed, low income countries. Despite greater concern and awareness among the world community, these trends have persisted. One reason for this phenomenon seems to be the unprecedented growth of population in this century. World population pressure and hunger for land is forcing more and more people to inhabit the earth's hazardous zones. It is not major changes in the earth's climate and structure that has led to an increase in disasters, but the concentration of social and economic activity in disaster-prone areas. Such human actions have increased the perception of "a natural event which threatens both life and property" as a hazard, a disaster being the realization of this hazard (Whittow, 1980).

The dichotomy in the human impact of disasters is explained by a recognition of the different abilities of rich and poor nations to take actions which mitigate losses. In industrialized countries, human encroachment into hazard zones, which are defended by a variety of human adjustments, have reduced loss of life but increased the

Table 3. Loss of life by disaster type and by continents 1947 — 1980

	Asia	Oceania	Africa	Europe	South America	Caribbean and Central America	North America
Floods	170,664	77	3,891	11,199	4,386	2,575	1,633
Typhoons, hurricanes and cyclones	478,574	290	864	250	—	16,541	1,997
Earthquakes	354,521	18	18,232	7,750	38,837	30,613	77
Tornadoes	4,308	—	548	39	—	26	2,727
Thunderstorms	20,210	—	—	120	60	310	244
Snowstorms	6,360	17	—	1,340	—	200	1,910
Heatwaves	4,705	100	—	340	135	—	2,190
Coldwaves	1,330	—	—	1,440	—	—	600
Volcanoes	2,805	4,000	—	2,000	440	151	34
Landslides	4,021	—	—	300	912	260	—
Rainstorms	1,648	—	5	26	145	—	49
Avalanches	335	—	—	340	4,350	—	—
Tidal waves	4,459	—	—	—	—	—	60
Fog	—	—	—	3,550	—	—	—
Sand and dust storms	150	—	—	—	—	—	10
Total	1,054,090	4,502	25,540	26,694	49,265	50,676	11,531

Not including droughts.

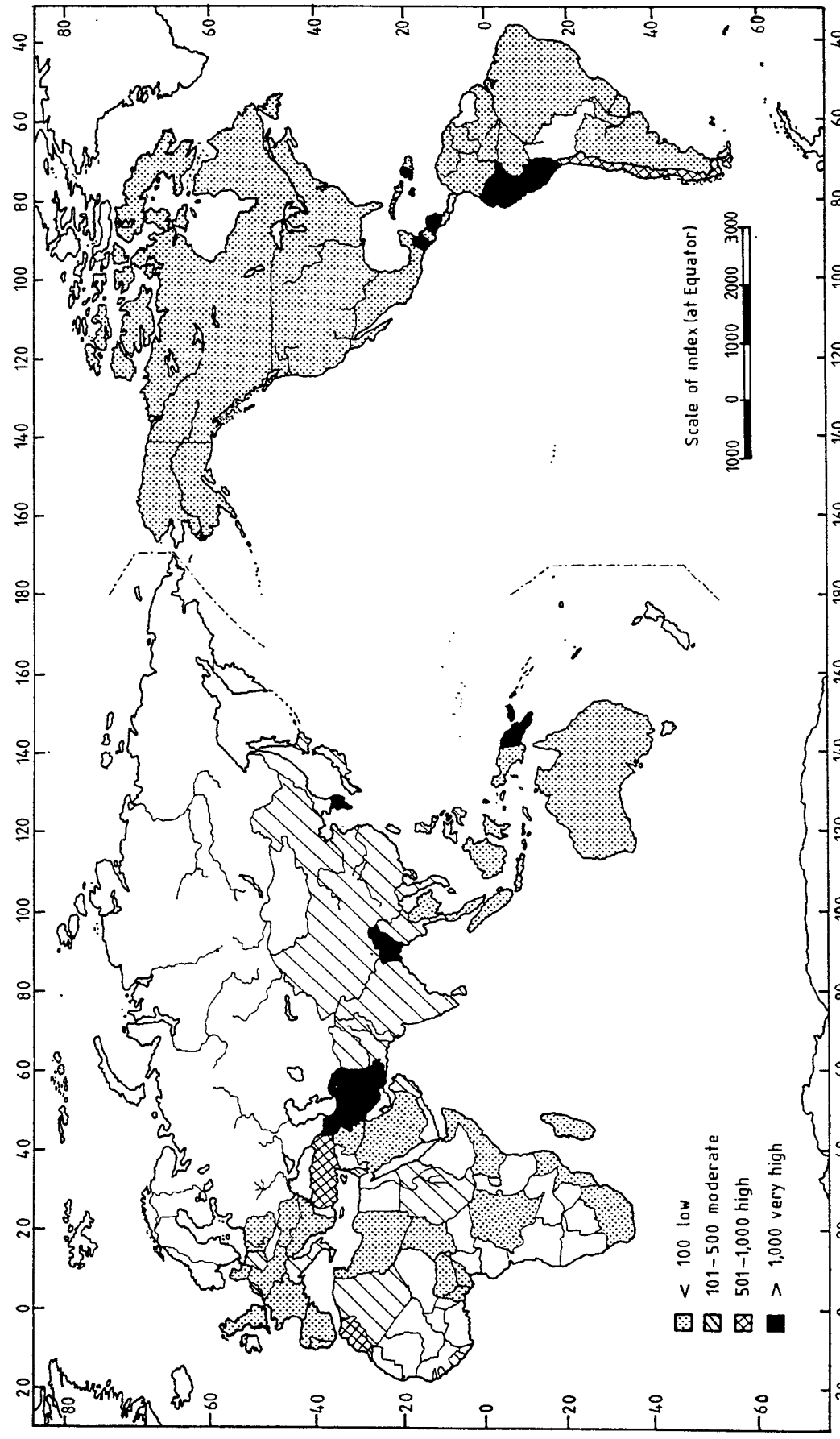

Fig. 2. Deaths per million population

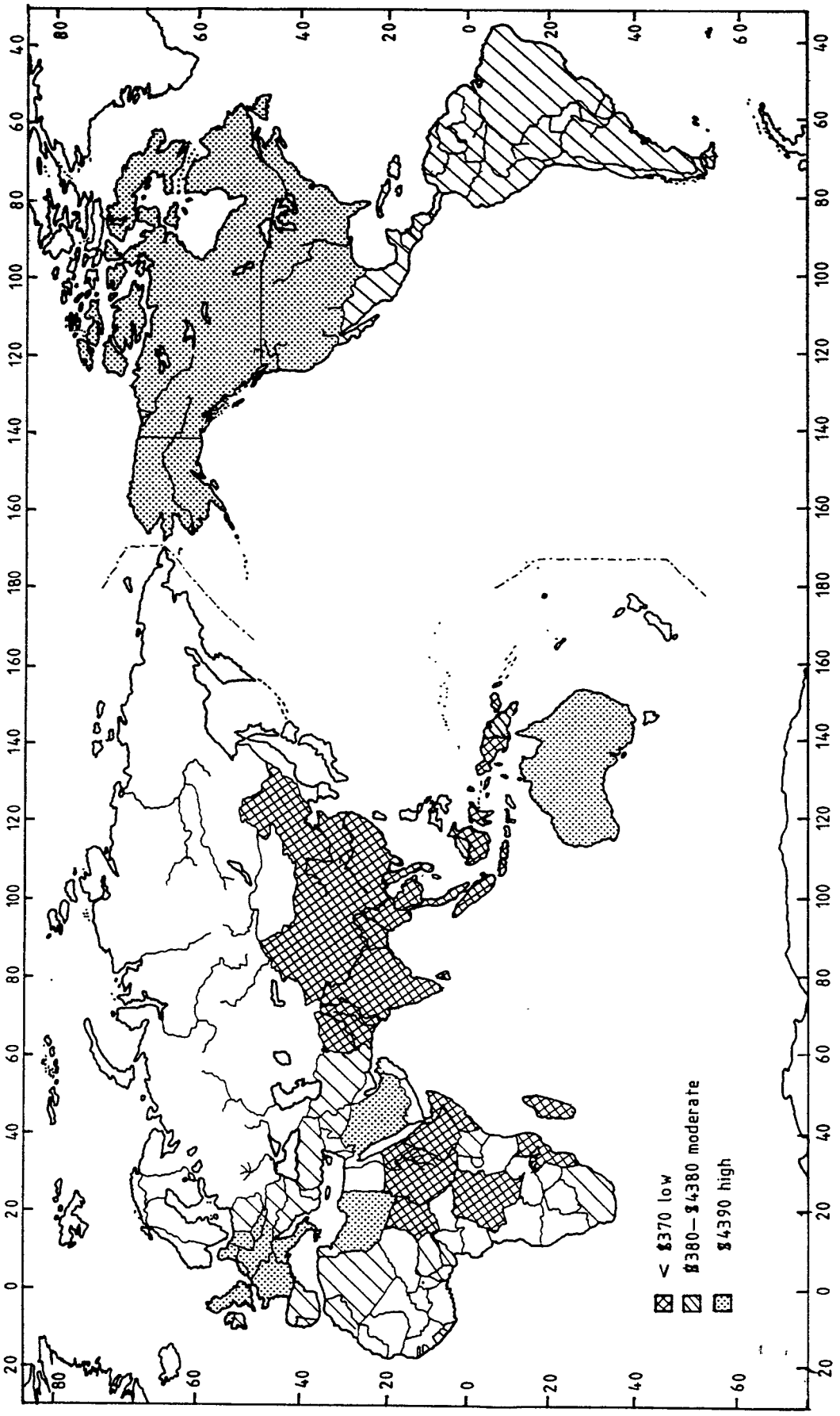

Fig. 3. GNP per capita (U.S.$ — 1979). Source: World Development Report 1981, The World Bank.

Table 4. Average loss of life per disaster impact by continents, 1947—1980

Continent	Lives lost (No.)	Disaster impacts (No.)	Average loss of life per disaster impact
North America	11,531	358	32
Central America and Caribbean	50,676	80	633
South America	49,265	75	657
Europe	26,694	119	224
Africa	25,540	34	751
Asia	1,054,090	437	2,412
Oceania	4,502	16	281
Total	1,222,298	1,119	1,092

economic impact of a disaster. For example, it is known that more than 50% of the American population lives on or near its coastlines, thus increasing the risks from floods and storms. However, low death tolls from these hazards reflect the effectiveness of storm-warning systems, which are sophisticated enough to avoid catastrophic loss of life, as well as the mobility of the public. It is when a storm strikes a heavily populated, underdeveloped country that the greatest disaster occurs, as when 200,000 people or more died in the 1970 Bangladesh cyclone. Even if adequate warning could be given, there "remains the problem of the warning reaching each village in time, not to speak of each house in the village" (Islam, 1971). Evacuation to safer places is often not feasible when road networks are poor and transport facilities are inadequate.

This study suggests that an increase in the perception and awareness of hazards in the industrialized countries, and especially in the U.S., has led to physical and social adjustments, as well as effective predictive and preventive programmes which have curtailed loss of life from major disasters. But, at the same time, the poorest people in developing countries have become increasingly vulnerable to disasters.

One reason for this is the non-existence of any form of pre-disaster preparedness programmes in most of the disaster-prone developing countries. The risk against disasters is compounded by poor social policies, pressures on land and less than comprehensive development strategies which concentrate large numbers of the population at risk in disaster-prone areas. Bangladesh is a case in point: a densely populated nation, where the prevailing inheritance laws produce the sub-division and fragmentation of land into uneconomic holdings. Forced by the pressure on land, many have migrated southwards onto fertile, flat deltaic plains, subject to floods and tropical storms. However, the absence of an integrated public programme to deal with hazard risks and development of the area have increased the potential of loss. Public adjustments have concentrated on "engineering constructions such as protective embankments," while "changes in land use, and zoning of the coastal land have only been given cursory attention" (Islam, 1971).

Surveys carried out by The League of Red Cross Societies and the United Nations indicate that in very few of the developing countries threatened does any form of pre-disaster planning or effective preparedness exist. And if plans exist, there is neither the machinery or resources to implement them. International agencies such as UNDRO, USAID, The League of Red Cross Societies provide disaster aid, but the major part of their available resources are allocated to relief activities.

This study proposes that future research into the social impact of natural disasters should involve a complete re-examination of the period from 1947 onwards, utilizing sources of data available in each individual country, as well as the knowledge gained from perception studies carried out in a variety of cultures and environments. It is suggested that this examination should be a continuous process taking into account any changes in the social and physical systems that occur over time. In conjunction with this study, a world-wide disaster education and training programme should be implemented. Programmes which provide the means of developing indigenous resources to ensure rapid and co-ordinated deployment of relief and to mitigate losses. The only obstacle is the availability of adequate resources to implement such programmes and studies.

Acknowledgements — I would like to acknowledge the assistance and time given by my tutor Dr Judith Rees and the staff at the International Disaster Institute in London.

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