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# Half a Century of Natural Disasters in the Pacific Basin: Historical Perspectives on the Future

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*This paper briefly explores and comments on three interrelated themes: the natural riskiness of the Pacific Basin; recent changes in patterns of disasters; and trends in society and environment that may affect the potential for future disasters. Losses of life due to disasters appear to be declining in recent decades throughout much of the region except in Latin America and Southeast Asia, where they may be increasing. Environmental and societal changes in the Basin are likely to produce new types of disaster potential that may modify historical patterns of disaster.*

## Introduction

Residents of the Pacific Basin have long been exposed to serious threats from extreme natural events and the region has been identified with great catastrophes throughout much of recorded history (Note 1). But, many Pacific countries have recently made significant strides toward reducing the impact of natural disasters (Mitchell 1989). Disaster-related deaths have been considerably curbed throughout developed countries like the United States, Canada, Japan, Australia and New Zealand. Major progress has also been made among some states of the East Asian mainland such as Hong Kong and South Korea. In recent years much of the burden of disaster deaths and other losses has shifted away from East Asia towards Southeast Asia and Latin America (Note 2). Though absolute economic losses are heaviest among the Basin's developed countries, the relative economic burden of disasters is undoubtedly heavier in the region's developing countries.

Future patterns of disaster in the Pacific Basin may differ from those of the past because of new environmental and societal developments. Processes of global climate change may affect the region in difficult-to-foresee ways (Henderson-Sellers and Blong 1989; Mitchell and Ericksen 1992; Devine 1992). New types of hazard are emerging as a consequence of new technologies and new resource uses. New forms of marine hazards are

developing along with unprecedented amalgams of technological and natural hazards. As elsewhere in the world, societal upheavals are restructuring governments and cultures throughout the Pacific region, and it is possible that new perceptions of disaster and new systems of disaster management will, in time, emerge. In light of these prospective changes, it is worthwhile to take stock of the present status of disasters in the Pacific Basin and to assess recent trends. Hopefully, this analysis will provide both perspective on past achievements in disaster reduction, as well as establish a point of departure for assessing future developments.

## Is the Pacific Basin Becoming Less Hazardous?

Few regions are more often associated with extreme natural events than the Pacific Basin (Note 3). It is encircled by the "Ring of Fire," a band of high mountains punctuated by most of the world's active volcanoes and underlain by the world's most seismically active areas. These primary geological risks often trigger potentially destructive secondary events including most of the world's tsunamis, many of its largest landslides, and a wide range of other mass movement phenomena. Nor is the Basin lacking in meteorological extremes. A majority of the world's tropical cyclones are spawned here; and drought is a common feature on its small islands and continental margins. The lower reaches of great Asian rivers that cross the basin's western flank are periodically inundated by vast damaging floods. This region is also home to ENSO (El Nino Southern Oscillation), a periodic ocean temperature fluctuation that gives rise to accentuated weather extremes throughout much of the world for years at a stretch. The importance of extreme natural events in human affairs is signalled by their incorporation in the Basin's many cultures. Ancient religions and modern myth systems in Bali, Papua-New Guinea, New Zealand, Hawaii, Mexico, Japan, California and many other places echo the importance of earthquakes, volcanoes, storms and floods (see Blong 1982; Public Broadcasting Service 1990). Formal and informal human adjustments to natural hazards are also well-established features of everyday life throughout the region (Klee 1980).

In light of this heritage of risk and risk awareness, it is not surprising that the Pacific Basin has been a venue for grave natural disasters. Indeed, the history of this part of the world has been marked by major disasters such as the Haiphong (Vietnam) tropical cyclone of 1881 (300,000 deaths); the Krakatoa volcanic eruption and tsunami of 1883 (36,000 deaths); the Hwang Ho (China) floods of 1887 (900,000 deaths); and the Tokai (Japan) earthquake of 1923 (140,000 deaths). Despite such a catalog of historic catastrophes, in the course of the past century the Pacific Basin may have

lost its perceived status as the world's disaster leader. Since the end of World War II, in particular, natural disasters have been fewer and less severe than might be expected, given the magnitude, frequency and range of incident natural extremes. Whereas Pacific Basin countries account for 46% of the world's population and about half of its land area, their share of known disaster deaths is believed to be much less (Note 4).

It is not possible to substantiate this observation in a conclusive way because of the limitations of disaster loss data, but available figures for better-documented large disasters are suggestive (Note 5). Table 1 indicates that, during the past half century, South Asia has been more frequently and severely affected by such disasters than any other region. Detailed data for selected states such as Japan, Hong Kong and South Korea clearly support the finding that many East Asian countries no longer suffer the scale of disaster casualties that they once did (Mitchell 1989). If some countries have managed to bring about quite impressive reductions in numbers and severity of disasters since the end of World War II, what lessons does this hold for other countries in the region and elsewhere? Are we looking here at the results of spinoff from successful economic development programs; or are other factors at work?

**Table 1. Natural Disasters that Involved 10,000 or More Deaths (1946-91)**

| Year | Event | Country | Deaths |
|---|---|---|---|
| 1949 | Floods | China | 57,000 |
| 1954 | Floods | China | 40,000 |
| 1960 | Earthquake | Morocco | 12,000 |
| 1962 | Earthquake | Iran | 12,000 |
| 1963 | Tropical Cyclone | Bangladesh | 22,000 |
| 1965 | Tropical Cyclone | Bangladesh | 17,000 |
| 1965 | Tropical Cyclone | Bangladesh | 30,000 |
| 1965 | Tropical Cyclone | Bangladesh | 10,000 |
| 1968 | Earthquake | Iran | 12,000 |
| 1970 | Earthquake | Peru | 67,000 |
| 1970 | Tropical Cyclone | Bangladesh | 250,000 |
| 1971 | Tropical Cyclone | India | 10,000 |
| 1976 | Earthquake | China | 242,000 |
| 1976 | Earthquake | Guatemala | 24,000 |
| 1977 | Tropical Cyclone | India | 20,000 |
| 1978 | Earthquake | Iran | 25,000 |
| 1985 | Tropical Cyclone | Bangladesh | 10,000 |
| 1985 | Earthquake | Mexico | 10,000 |
| 1985 | Volcanic Eruption | Colombia | 22,000 |
| 1988 | Earthquake | USSR (Armenia) | 25,000 |
| 1990 | Earthquake | Iran | 40,000 |
| 1991 | Tropical Cyclone | Bangladesh | 125,000 |

Any attempt to answer the preceding questions must take account of the fact that different countries have addressed the task of reducing disaster losses in quite different ways. For example, in the field of flood hazard management the Japanese preference is for capital intensive,technologically sophisticated structural measures. These can be contrasted with Chinese systems that have increasingly taken advantage of natural topographical depressions for temporary storage of runoff combined with extensive use of human labor and modest structural technologies (Note 6); or a United States flood plain management system that has made considerable use of non-structural measures such as land use controls and insurance. Methods of coping with forest fire and brush fires show marked variations among countries, although similar strategies are sometimes employed at different times. For instance, Australians are now preparing

> to move into wilderness fire management, which the American fire community is leaving, while Americans are preparing to advance into the ex-urban fire scene, complete with volunteer fire brigades, of which Australians have had long experience.... When Americans and Australians talk fire, as an exercise in international mateship, they speak always with great good-will and almost always they speak past one another (Pyne 1991, p. 282).

Observations such as these underline the limitations of assumptions that knowledge about disaster-reduction is a "frictionless" commodity that can easily move around the international community.

## Patterns of Disaster 1946-1991

Table 2 includes all known sudden-onset natural disasters in the Pacific Basin since the end of World War II that have killed at least 1000 people. However, it is an incomplete record for several reasons. For instance, major disasters sometimes go unreported at the time of their occurrence and data records are not always adjusted in retrospect. Disasters that resulted in fewer than 1,000 deaths are not included in this tabulation. The bulk of extreme events individually kill relatively small numbers of people, but their aggregate impacts may be comparable or greater than those of the catastrophic disasters shown here. Indeed, it quite likely that most global disaster data bases systematically underestimate losses of human life. For example, one recent study suggests that global death tolls due to disasters may be up to four times larger than those that are recorded by the mass media (Mitchell 1989). There is also the question of whether deaths (or a combination of deaths and injuries) is an adequate indicator of disaster. Many current definitions of disaster recognize this limitation and now highlight the degree

of social disruption and community capacity to overcome disaster (Britton and Oliver 1991). Despite these and other limitations, Table 2 provides an approximate picture of the varying hazardousness of the Pacific Basin. Four general conclusions can be drawn from it.

First, the frequency of disasters has varied widely from decade to decade. It is clear that the late 1940s were particularly disastrous years. During that time, an estimated 81 500 people died in 12 disasters over a four year period. It is not known whether extreme natural events were more frequent during the late 1940s than at other times, but the general disarray among national governments in the post-war years, and the lack of a well-developed international capacity for providing either warnings or relief, may have contributed to the high tempo of disasters at this time (Kent 1987). In no comparable subsequent period has the number of significant disasters approached this level (with the exception of the years 1972-76, this was also the most deadly half-decade of recent times). Disasters were common during the 1950s, 1970s, and 1980s; but fewer occurred during the 1960s.

Second, as measured by deaths, the burden of losses from disasters was heaviest during the 1970s. The single most deadly event occurred in 1976, in Tangshan, China (where an earthquake killed an estimated 240 000 people), but even without this great catastrophe, the seventies would still have been the period of heaviest losses. Death tolls were relatively modest during the 1980s.

Third, earthquakes (19), and tropical cyclones (15) have been the most frequent types of disaster, but floods were also significant (10), especially during the late forties and early fifties. Overall, earthquakes inflicted the heaviest death tolls (402,700), followed by floods (114,400). Tropical cyclones (26,300) and volcanic eruptions (22,000) accounted for smaller numbers of casualties. Tsunamis and avalanches also produced disasters. Most other types of extreme events have not posed significant threats to human life, with the possible exception of heatwaves and droughts. For example, during July 1988 a drought in the central and southern provinces of China is reported to have taken around 1440 lives (Blong 1991; Swiss Re 1989).

Fourth, there has been a well marked shift in the locus of serious natural disasters. Although East Asia and Southeast Asia have accounted for most disasters (31), the great majority of these (20) occurred before 1965. By contrast, nine of Latin America's fifteen recorded disasters date from the early 1970s. No large deadly disasters occurred in the United States, Canada, Australia or New Zealand at any time, or in Japan after 1959. It is

**Table 2. Major Natural Disasters in Pacific Basin Countries 1946-1991**

| | Date | Country | Type | Deaths |
|---|---|---|---|---|
| 1. | 1946 | Japan | Earthquake | 1,100 |
| 2. | 1947 | Japan | Tropical Cyclone | 1,000 |
| 3. | 1947 | Hong Kong | Tropical Cyclone | 2,000 |
| 4. | 1948 | China | Floods | 1,000 |
| 5. | 1948 | Japan | Earthquake | 3,200 |
| 6. | 1948 | China | Floods | 1,000 |
| 7. | 1948 | Taiwan | Earthquake | 1,200 |
| 8. | 1949 | China | Floods | 57,000 |
| 9. | 1949 | Ecuador | Earthquake | 8,000 |
| 10. | 1949 | China | Tropical Cyclone | 1,000 |
| 11. | 1949 | Guatemala | Floods | 4,000 |
| 12. | 1949 | Korea | Tropical Cyclone | 1,000 |
| 13. | 1951 | China | Floods | 1,800 |
| 14. | 1951 | Papua-New Guinea | Volcanic Eruption | 3,000 |
| 15. | 1953 | Vietnam | Tropical Cyclone | 1,300 |
| 16. | 1954 | China | Floods | 40,000 |
| 17. | 1954 | Japan | Tropical Cyclone | 1,600 |
| 18. | 1956 | China | Tropical Cyclone | 1,950 |
| 19. | 1956 | China | Tropical Cyclone | 2,100 |
| 20. | 1959 | Japan | Tropical Cyclone | 5,000 |
| 21. | 1959 | Mexico | Tropical Cyclone | 1,450 |
| 22. | 1960 | Peru Bolivia Chile | Earthquake | 2,200 |
| 23. | 1960 | Chile | Earthquake | 5,700 |
| 24. | 1962 | Peru | Avalanche | 3,500 |
| 25. | 1963 | Indonesia | Earthquake | 1,100 |
| 26. | 1964 | Vietnam | Floods | 7,000 |
| 27. | 1970 | China | Earthquake | 10,000 |
| 28. | 1970 | Philippines | Tropical Cyclone | 1,500 |
| 29. | 1970 | Peru | Earthquake | 67,000 |
| 30. | 1972 | Nicaragua | Earthquake | 7,000 |
| 31. | 1974 | Honduras | Tropical Cyclone | 5,000 |
| 32. | 1976 | China | Earthquake | 242,000 |
| 33. | 1976 | Guatemala | Earthquake | 22,700 |
| 34. | 1976 | Philippines | Earthquake | 8,000 |
| 35. | 1976 | Indonesia | Earthquake/tsunami | 5,000 |
| 36. | 1981 | China | Floods | 1 300 |
| 37. | 1982 | El Salvador | Floods | 1,300 |
| 38. | 1984 | Philippines | Tropical Cyclone | 1,400 |
| 39. | 1985 | Mexico | Earthquake | 10,000 |
| 40. | 1985 | Colombia | Volcanic Eruption | 22,000 |
| 41. | 1986 | Solomon Islands | Tropical Cyclone | 1,000 |
| 42. | 1986 | El Salvador | Earthquake | 1,500 |
| 43. | 1987 | Ecuador | Earthquake | 4,000 |
| 44. | 1990 | Philippines | Earthquake | 1,600 |
| 45. | 1991 | China | Floods | 2,300 |
| 46. | 1991 | Philippines | Tropical Cyclone | 4,000 |

Almost 46% of the world's population now lives in countries that touch the Pacific Ocean and these states account for half of the world's land area (NOTE 2), but the region's share of known disaster deaths is disproportionately low.

also worth noting that the Philippines is an increasingly frequent site of major disasters and other developing countries, that had not showed up on the list before 1980, are now beginning to appear on it (e.g., El Salvador, Solomon Islands—Britton 1987).

These findings underline the growing importance of contextual factors in Pacific Basin disasters. The biggest threats to human life and property (i.e., earthquakes, cyclones, floods) gain their potential for destruction because they are closely intertwined with fast-evolving new societal systems that are freighted with their own sets of uncertainties and problems which act to increase vulnerability to disasters. These interrelations are most clearly manifest in large cities, especially in developing countries. Places like Tientsin (China) and Lima (Peru) face major hazards not simply because they lie near active faults, but also because they are experiencing unprecedented population growth, sociopolitical upheavals and changes in lifestyles. At the same time, these locations are experiencing the results of major shifts in international economic systems that may alter their resilience in the face of extreme events. Human involvement with riverine floods and coastal storms is even more complex and subject to uncertainty. When ongoing societal changes are superimposed on prospective changes in climate and other environmental processes, it becomes increasingly difficult to project future patterns of hazard and disaster. Nevertheless, it is clear that an increased burden of losses is more likely to fall sooner and heavier on countries and communities that are currently failing to provide adequate protection for their occupants. The next section discusses some additional relationships between disasters and socioenvironmental contexts in the Pacific Basin.

## New and Emerging Potentials for Disaster

Natural disasters throw into relief many of the central public issues that confront people who live in the Pacific Basin. Links between disaster susceptibility and economic development have already been noted. Other major themes that intersect with disasters include: global climate change; the exploitation of marine and coastal resources; urbanization and rural depopulation; the decline of remoteness and the potential for cooperative initiatives among formerly separate groups; and the general process of technology transfer as well as its impact on indigenous populations.

For example, marine hazards are a growing problem in the region. Marine resources provide a large and increasing proportion of the food supplies and industrial raw materials for land-based populations. They include artisanal and commercial fisheries and mariculture industries; off-

shore oil and gas fields; nearshore hard minerals like tin and deep water minerals like manganese; ocean thermal energy schemes; marine parks and maritime tourism. Marine transportation is also a central concern of many governments in the region both because it is essential to the transshipment of goods and people and because of the pollution and safety hazards that are posed for ocean and offshore waters. Compared with land-based populations, disproportionate losses are often inflicted on users of these resources by natural hazards, and it is often the desire to protect against natural hazards that is the main driving force for the development of new marine resource technologies. For example, tropical cyclones pose special threats to fishermen in poor countries who go to sea in flimsy craft that lack radio communications. The problem is particularly serious in southeast Asian countries like Vietnam, the Philippines, and Indonesia (Morgan and Valencia 1982). If natural disaster reduction programs are to succeed in such places, there is a clear need for research on the special problems of marine resource development in the face of natural and also technological hazards, and for fostering hazard mitigation systems that are appropriate to marine resource users.

New amalgams of natural and human-made hazard are being created as hazardous technologies and hazardous facilities like oil terminals; waste storage sites; industries that manufacture toxic substances; nuclear power plants; and radioactive waste reprocessing firms are located in floodplains; near fault lines; on unstable slopes and in other areas that are exposed to natural hazards. Japan and several small oceanic islands are already beginning to experience serious environmental and political repercussions from this nexus of problems (Huddle and Reich 1987). Given the extent to which potentially dangerous industrial technologies are being developed within the Pacific Basin or imported into it from elsewhere, and in light of events like the **Exxon Valdez** oil spill and similar accidents off the coasts of Southeast Asia and Latin America, grave new problems are likely to face those who are charged with reducing the future impacts of natural disasters.

## Conclusions

This brief overview of Pacific Basin disasters during the past half century leads towards several conclusions. First, it offers hope that disasters can be reduced in the form of evidence of past successes—not only in the region's more developed countries (i.e., North America, Japan, Australia and New Zealand), but also in parts of East Asia. This message of hope is tinged with caution concerning assumptions about the trans-national transferability of disaster-reduction technologies and information. We know

relatively little about what makes one type of policy or program acceptable at some times in some places and unacceptable at other times and places. And we know even less about why some approaches to disaster reduction emerge in certain communities and countries just as they are going out of favor in others. Finally, the entire future of disaster management is overlain by uncertainty about the extent to which burgeoning societal and environmental changes may alter the calculus of hazard in the waning years of the twentieth century and the early decades of the twenty-first century. The challenge for analysts of natural hazards and natural disasters is to find ways of putting knowledge about "what works" into practice where it will do the most good, while remaining sensitive to the capacity of the hazards universe to assume new and unexpected forms that demand innovative responses.

## Notes

1. As used in this paper, the term Pacific Basin includes the Pacific Ocean and all contiguous countries. This includes 31 large countries located on continental mainlands (e.g., Mexico, South Korea) or major islands on the fringes of the continents (e.g., Taiwan, New Guinea), as well as half a dozen oceanic archipelagic states (e.g., Fiji, Solomon Islands). The complete list includes: Chile, Peru, Ecuador, Colombia, Panama, Costa Rica, Nicaragua, Honduras, El Salvador, Guatemala, Mexico, USA, Canada, Russia (USSR), Japan, North Korea, South Korea,China, Taiwan, Hong Kong, Vietnam, Cambodia, Thailand, Philippines, Malaysia, Singapore, Indonesia, Brunei, Papua New Guinea, Australia, New Zealand, Fiji, French Polynesia, New Caledonia, Solomon Islands, Vanuatu, and Western Samoa.

2. See, for example, the Latin American case studies of disaster impacts and recovery reported in Maskrey (1989). It is worthwhile noting that despite evident progress in reducing some types of loss, China continues to be affected by major disasters, especially during periods of sociocultural ferment (See Kane 1988; Office of the United Nations Disaster Relief Coordinator 1991).

3. An excellent cartographic introduction to extreme natural events in the Pacific Basin has recently been prepared by a multi-agency team and published by the U.S. Geological Survey as a contribution to the International Decade for Natural Disaster Reduction. See Lockwood et al. (1990).

4. In 1991, Pacific Basin countries had an estimated population of 2,458 900,000 and a total land area of 29,076,440 square miles.

5. Data used in this paper is derived from a variety of sources including reports of the United Nations Office of the Disaster Relief Coordinator; the

U.S. Office of Foreign Disaster Assistance; the Swiss Reinsurance Company; and newspaper accounts. Where these sources gave different estimates of disaster losses, the most conservative (i.e., lower) estimate was accepted. As noted in Mitchell (1989), undercounting of losses is probably more common than overcounting, largely because the international and national agencies that compile records of loss, miss many of the smaller scale local events.

6. It should be remembered that over the centuries China has constructed some of the world's most elaborate flood defense works; and that the government of the PRC has recently approved plans to continue this tradition in the form of the massive Three Gorges scheme on the Yang Tze river. However, during the past several decades, massive flood control dams have been less in evidence than previously and there was unprecedented public opposition to the Three Gorges scheme by one third of the national congress deputies.

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