A Hazard Need not a Disaster Make:
Rural Vulnerability and the Causes of 'Natural' Disasters

Terry Cannon, Institute of Social Studies

Please note: this paper must not be quoted without permission. It incorporates sections of my contributions in P Blaikie, T Cannon, I Davis & B Wisner At Risk: hazards, vulnerability and the causes of disasters London: Unwin Hyman 1991 (provisional title). The sections on flood disasters have also appeared in the paper Rural People, Vulnerability, and Flood Disasters in the Third World (ISS Working Paper Series No 90, August 1990) The book is aimed at students, government officials, activists, NGOs and others in the North and South who are interested in the realisation that disasters are not natural, and that planning for them must take account of peoples' vulnerability as well as the necessary technical measures. Comments and criticisms that can assist in this function are especially welcome

1 Introduction

Not very many years ago, most people assumed that the disasters associated with earthquakes, hurricanes, floods and other natural hazards were themselves natural. It was accepted that their impact could be reduced (through attempts at preparedness, mitigation and post-event humanitarian action), but the emphasis (including in much academic and policy work) was on the naturalness of disaster events. There has long been an awareness that some disasters, which may resemble those usually blamed on nature, are inherently caused by human action (as with famines triggered by war). But this perception was limited and has not easily been extended to an explanation of how other disasters might have less obvious, more complex, but just as significant links with human causes.

This paper intends to clarify those less obvious human connections between natural hazards and disastrous outcomes. It argues that hazards are natural, but that disasters are not. A disaster should not be seen as the inevitable outcome of a hazard's impact. In place of much previous emphasis in disaster work on the natural (which has led to a dominance of technical efforts focussed on modifying the hazard), the stress here is on the condition of the people which make it possible for a hazard to become a disaster: both the extent and types of vulnerability, and the manner in which society deals with the hazard in terms of mitigation and preparedness (that is, the non-neutral impact of the technical interventions themselves which are supposed to reduce disaster intensity). The first part of the paper develops a critique of conventional approaches to disasters, and argues for the use of vulnerability analysis as a significant framework for understanding disasters and the development of better policy interventions. The second part examines the impact of flood hazards on rural people in the Third World, and illustrates how disasters occur non-naturally in respect of one type of hazard and the related patterns of vulnerability of people in flood-prone areas. The flood hazard has been chosen partly because it is the most common one affecting the world, is particular significance for rural people in the Third World, and because attempts to deal with it are still dominated by the 'technical fix' approach of large-scale capital investment and insensitivity to local peoples' vulnerability and livelihood needs.

1.1 Disasters are not natural

That many more people now accept that human activity itself has created the conditions for disaster events is partly because of the growth of awareness that through negligence or inappropriate response, social systems have made a disaster out of a situation which otherwise might not have been so serious. This is one factor, if a rather negative one, which has been at work. Others are more positive, resting on the understanding that it is hazards that are natural, but that for a hazard to become a disaster it has to strike vulnerable people. The last two decades has seen a growth in the use and analysis of the vulnerability concept by academics and development practitioners, who have been demonstrating how disasters are a product of economic and political factors. This shift in opinion is a vital step in the creation of a new international framework of thought and action for avoiding disasters.

Another reason for the shift is the growth in awareness of development problems and the difficulties of improving peoples living standards in Third World countries. Many people now realise that disasters in the Third World are often only a more acute, more extreme form of the general chronic daily suffering of many of the people. There is a realisation that explanation of the entire set of problems is required, rather than understanding of the 'natural' disaster in isolation. Another reason for the new awareness is the more widespread recognition of human destruction of the environment, and that natural hazards themselves can be precipitated (or exacerbated) by the normal' pursuit of economic and social goals.

But there are two other reasons why attitudes have changed, especially among people in Western countries. First has been the growing critique of international inequalities, including the awareness of the surplus of food in the West contrasted with the dearth in Africa. Although many people may not be aware that a transfer of this surplus will not solve the problems, it at least showed them that something was wrong with 'nature' as an explanation. Secondly, and linked with the first, the widespread civil unrest and wars in areas affected by famine (in Ethiopia and Sudan especially) showed, even if in a rather crude manner, that the famines were at least partly man-made. The outcome is that more Westeners than perhaps has ever been the case are conscious that economic and political factors are causes of disasters, and that (in those instances at least) famines are not simply a result of the lack of rain.

Although it may appear to have been of rather less significance in creating the new awareness, academic work has also played its part, especially because some of those in the forefront of academic work have also been involved in peoples' struggles, consultancies, NGOs and other bodies which have both led them to develop their ideas and received their thinking in turn.

Yet there are gaps in this new awareness, or rather it is a patchy and unconnected set of ideas. Much of it is a product of reactions to single events (eg Ethiopian famine) or particular processes (eg deforestation and desertification), and fails to connect a wider range of phenomena. While the new awareness is to be welcomed, it is still incomplete and not yet universally accepted. Even the focus of the 1990s United Nations.'International Decade for Natural Disaster Reduction' (my emphasis) betrays the strength of the old outlook.

The processes which make people more or less vulnerable are largely the same as those which generate differences in wealth, control over resources, and power, both nationally and internationally. The vulnerability concept is a means of 'translating' everyday and known processes of economic and political separation of people into a more specific identification of those who may be at risk in hazardous environments. It is important that recognition is given to the difference between vulnerability and poverty.

The emphasis which many of those involved in 'disasters work' have placed on economic and political factors as the 'causes' of disasters seems to be percolating through to the public, to aid workers, and even to some governments. Something which has been obvious

to some of the victims of disaster - that their suffering is not simply the result of an act of God - is being understood. But we need to keep in mind also that the perpetual hardship of many people has made it necessary for some to rely on forms of supernatural explanation of their hardships; it is not always possible to rely on the people's consciousness. In this context, it can be argued that outside 'advocates' are needed to force the issues to prominence for some communities (see on this Ignatieff 1984).

It is easy to identify war and civil disturbance as being among the relevant economic and political factors. What is more difficult and yet essential is to identify the processes and conflicts which generate and maintain vulnerability to disaster in the more general day-to-day sense, often in places where there is no war. This is more difficult to substantiate, because it usually involves analysis of the means by which some people live (and survive disasters the better) at the expense of others. While many will condemn wars, and be critical of desertification, famine and pestilence, or population growth, there is more reluctance (especially amongst those who have power and who are beneficiaries) to accept that the conditions which create vulnerability in some people have as their counterpart the creation of a more comfortable life for others.

This conflict of economic interests is one of the most intractable barriers to the mitigation of disasters. It is evident in widely different circumstances. These include the enforced marginalizing of people onto less productive land, or the need for those who earn low wages, have few resources, or are discriminated against, to live in particular situations in which hazards strike more harshly.

In the first type of case, the move is so that superior land can be used for commercial agriculture or ranching, and the losers are made more vulnerable to drought and other hazards (as for example with the exclusion of the Afar from the Awash valley in Ethiopia in the early 1970s, the Masai in Kenya during and after colonial rule, or farming people in Niger who lost land to the French-managed cotton project. In the second, examples include the need for those dispossessed of land or other income opportunities in Bangladesh to live in extremely flood-prone areas of the delta (Clay 1984), the unemployed and those on low wages having to live in insubstantial housing located on unstable slopes in many cities (e.g. Rio de Janiero), and the poor living in buildings which landlords and governments fail to proof against earthquakes, including situations where contractors have profitted from the use of inferior materials

To see disasters as being natural is about as useful as a doctor signing a death certificate with the explanation of 'natural causes'. It gives no indication as to whether the person's life might have been extended by a different social system which allocated resources and regulated risks in a different way, for instance by the

- provision of a better diet (thus increasing physical and mental ability, longevity and resistance to disease),
- removal or reduction of health hazards from the workplace,
- preventive measures against self-damaging behaviour such as drug taking (including cigarettes and excessive alcohol),

- existence of a health care system which makes early diagnosis and treatment possible (including appropriate technological interventions) of many 'natural' causes of death
- good access to scientific knowledge of the functioning of the human body and of the influences on it of factors such as diet and toxins.

Of course the analogy with disasters is not perfect but the parallels are there. In disasters associated with natural hazards, it is much more useful to understand how the political and economic processes in a society:

- allocate income and resources, including the impact of this on different groups and individuals in terms of their ability to cope with hazards (in nutritional, resource [access] and recoverability aspects),
- affect the degree of preparedness and mitigation through the level of scientific concern, resource allocation, and type and extent of technical preparation,
- assign resources for the reduction of the impact of hazards,
- determine the level of scientific knowledge of both hazards themselves and their impact, and the allocation of the resulting technologies as means for intervening to reduce their intensity or impact,
- the influence of mitigation policies (who they affect and are effective for; the nature of the technology involved; the level of capital spending allocated; the amount of capital available)
- determines the influence of international economic systems on all these.

Obviously, the people would not die were it not for the factors which are inadequately labelled 'natural causes'. But such information on the death certificate is hardly informative about the underlying reasons for the many medical conditions which can hasten death. Equally in an earthquake, were it not for the ground shaking there would not be the potential for deaths, injuries and disruption. But this is far from being the same thing as saying that the earthquake caused an associated disaster.

The analogy can be extended. For various reasons 'natural causes' can be recorded on death certificates because the medical profession, another interest group, or even the state, wishes to supress the 'real' cause of death. The reasons may be personal, social or political (to protect the feelings of family or the reputation of the state). Similarly, it has served some political interests to maintain the notion that disasters are natural rather than 'caused' by political and economic processes. The view here is that hazards are natural, but that the disasters associated with them in most situations are not.

Someone who dies in their nineties might be said without much controversy to have died from natural causes, since there is little likelihood that any modification of lifestyle or medical intervention could have delayed it further. In disasters there are also cases which reach the limits of the analysis presented here, and which are similarly - or at least partially - natural. For instance, with locally unknown or unforseen hazards, or hazards with very long return periods, it is difficult to ascribe to human action any disastrous outcome connected with such hazard events (although there is an argument that human inaction should be blamed where there is a body of scientific knowledge that could have

been used to warn of such occurances). But in general disasters are not natural: they happen to people who are put at risk as a result of their vulnerability.[1]

1.2 Defining vulnerability

Vulnerability is a variable characteristic of individuals and groups of people who largely share the same social and economic circumstances relevant in generating particular vulnerable conditions. It is a complex condition produced by a combination of factors. To some extent the relationship of people to particular hazards may be a factor. In areas of the world where more than one hazard is likely to strike, the imact of one hazard may be less serious than another for the same group of people. One element of vulnerability is therefore specific to each type of hazard, in its interaction with the particular characteristics of people. For instance, some people may be more vulnerable to an earthquake than to a flood striking the same location. This variability in regard to the type of hazard might be a result of the places where a person lives or work being better protected against flooding than earthquakes. In general, this component of vulnerability is of less significance than those discussed next.

The major aspects of vulnerability consist in the characteristics of the individuals and different groups of people, whose position in terms of class, gender, or ethnicity results in hazards having different degree of impact. This is itself divided into three aspects: the first is the manner in which the particular livelihood system of an individual or group is made more or less robust and capable of resisting the impact of a hazard. (This can be called 'livelihood vulnerability', and is similar in some respects to Sen's concept of 'entitlement'. It includes the degree of 'health' (medical) and economic resilience in dealing with a hazard's impact, including the capacity for recoverability (another measure of economic strength and responsiveness to hazards). Second is the degree of protection an individual or group can grant to itself in terms of preparedness for a given hazard, for instance in the nature and strength of their building in an earthquake zone, or the price they can pay for building plots in relation to flood water levels. This can be termed the 'self-protection' element of vulnerability, and is in some respects linked to the economic advantages and disadvantages of high or low levels of livelihood (though it is not at all determined only by income or wealth). The third is the level of protection granted by the activities of the state or other elements which may intervene in determining the level of protection of particular people or groups from a hazard. This can be termed 'social-protection'. The two 'protection' elements depend on a range of factors which are clearly also linked to the major inequality factors in a society (class, gender and ethicity), but also relate to the level of scientific and technical knowledge (and the manner in which it is used).

A hazard may be seen to have a greater or lesser impact on a person or group according to that person or group's bundle of these characteristics from which they are granted a higher or lower level of vulnerability. The intensity of the hazard is therefore not so relevant to whether a disaster happens or not: a highly vulnerable group may be badly affected by a relatively weak earthquake, and a low vulnerability group little affected by a strong one. It is the degree of vulnerability of people in the area of the hazard strike which counts. The number of people at a level of vulnerability to a hazard of a given

intensity will be a measure of the disastrous or non-disastrous impact of that hazard. It is therefore also possible for two earthquakes of the same intensity and characteristics to strike areas with similar population densities, and for one to be a disaster (in terms of mortality, injury, and disruption to livelihoods and future well-being) and the other to be a disruption with few deaths and injuries and with easy recoverability. The hazard is natural; a disastrous outcome is not, and is in many senses largely caused by the vulnerability conditions generated by human systems.

In this paper, vulnerability and vulnerable people or groups may be discussed in relation to different disasters without necessarily specifying how such groups are defined. There is an inherent danger of tautology, that this unspecified use of the concept can lead to a situation where after an event the victims are identified as those who were vulnerable. But I consider it possible to use vulnerability in a more precise and predictive manner, even to make socio-economic as well as spatial 'maps' of vulnerability. Such measures would help to improve preparedness and support arguments about the need for revision of the economic and political circumstances that generate vulnerability.

1.3 Vulnerability and the causes of disaster

The concern here is with the condition of the people which make it possible for a hazard to become a disaster: both the extent and types of vulnerability generated by peoples' positions within political and economic systems, and the manner in which society deals with the hazard in terms of mitigation and preparedness. Disasters happen when a natural hazard strikes vulnerable people. If people can be made less vulnerable or non-vulnerable, then a hazard may still strike, but will not produce a disaster. The vulnerability of a group can be improved by changes in the different components of their vulnerability bundle. Preparedness and mitigation measures are only one aspect, and so the development of scientific knowledge to make technical means of hazard reduction possible may have little or no effect, depending how other components of the vulnerability profile are altered. In general, more people in most Third World countries are vulnerable in both the lack (or inappropriateness) of preparedness measures (the level of protection), and in the socio-economic aspects (especially livelihood level and resilience).[2] But vulnerability analysis is valid in other situations, and there are clearly sizeable groups of people in the industrialised countries who are economically vulnerable even if they are able to reduce the vulnerability within socially-higher levels of spending on preparedness and mitigation measures, and share their livelihood damage and improve their recoverability through insurance.

1.4 Vulnerability and the difference between 'rich' and 'poor' countries

It is possible to realise that disasters are not solely 'natural' events through recognising that similar extreme hazard events have a very different effects on people and property depending which society or country they strike. The impact of a tropical cyclone on the coastline of India or Bangladesh invariably has far worse effects in terms of loss of life, injury and livelihood disruption than is the case with similar hurricanes in the United States (and it is not simply because of different population densities). There is a different level of preparedness, and certainly the ability of a wealthy country like the US to absorb the reconstruction costs (plus individuals' resilience to financial hardship through insurance

policies) means that post-event aid is of a different order. Likewise, the earthquake risk in California is anticipated in a way which is quite different to that in many parts of the Third World where the same hazard is faced. In these cases it appears that relative national wealth is crucial in modifying the intensity or impact of hazards so that they are less disatrous.

Nevertheless, vulnerabilty to disaster is no to be neatly distinguished as being absent in 'rich' countries; in the USA for instance, there is evidence that low paid/unemployed people (especially those who are discriminated against because of their ethnicity) are much more likely to suffer human and material losses in say hurricanes or earthquakes. The October 1989 Californian earthquake seems to have been more detrimental for Mexican migrant workers, and brought them less relief than other sections of the population. Despite their labour being indispensible to the agricultural economy of the state, their status as 'illegals' means that they are non-existant as far as most of the official response to disasters.

But the reason for the differential level of impact is more than just the wealth and orgnisational ability of different countries. It is better to analyse it in terms of the way in which people are made to be vulnerable to environmental hazards. More is needed than looking simply at how much money is spent on meteorological services and cyclone warning networks in different parts of the world, or the surplus available to a country which can be devoted to earthquake-proof buildings and planned relief systems. We need to understand how it is that - even in the wealthy USA - some groups of people are more prone to the impact of hazards than others, and why it is that in Third World countries in particular the numbers of victims is so much higher.

What turns a natural hazard into a disaster is not simply a question of money (eg how much is available within a given country to spend on precaution and alleviation). It is more a matter of why some people are more vulnerable than others, and of why some countries have more to spend, why known technologies are utilised in some parts of the world but seem more difficult to introduce in others, and why it is that certain topics are regarded as research and action priorities in some societies and not in others.

It requires analysis of the various economic and political systems (the different political economies of the world) and the way they structure societies, such that similar hazards lead to very different impact on one society compared with another. A given hazard may lead to disaster in one, but produce only a limited interruption in normal life for most people in another. In short, what needs to be analysed is how does the structure of a society determines the way in which a hazard is likely to affect it.

In the USA, the vulnerability of people to hurricanes is much less than in Bangladesh (or the countries of the Caribbean) because of both the generally higher levels of income (which enable recovery more easily), and the high degree of preparedness: vulnerability has been reduced in both the economic conditions of livelihoods and the economic/social framework of self and social protection. But as already suggested, such reductions in the vulnerability of most people does not prevent the application of the same sort of analysis

to discover who and which groups are vulnerable even in the wealthiest parts of the world: class, gender and ethnicity are still likely to be indicators of the variable impact of hazards.

1.5 Vulnerability is not the same as poverty

Already, this twofold division of vulnerability indicates that it sould not simply be equated with poverty. Vulnerability includes an economic element, generated by the position people have in the access to resources and income in a society and the element of variable protection of different people against specific hazards. If people are in an area prone to tropical cyclones, they may be affected in different ways by virtue of their 'economic' vulnerability (produced by their class, ethnic and gender position), but all may be vulnerable to the hazard in more equal terms if there is a lack of warning systems and a more general inadequacy of mitigation measures. This is one sense in which it is clear that vulnerabilty is not the same thing as poverty.

The two elements of vulnerability (one relates to livelihoods, the other to the differential effectiveness of hazard preparedness and reduction) are also distinct, and may not always overlap completely. While the livelihood and self-protection elements may strongly relate to indices which are generated by class, gender and ethnic position, and of the consequent level of wealth and income, social-protection may not. This means for example that there could be high levels of vulnerability in an area prone to earthquake among middle-class occupants of unsafe housing, while the poor live in dwellings which are so flimsy that their collapse does not kill or injure so many.

There are other reasons not to equate vulnerability with poverty. Firstly, poverty is a consequence largely of class and ethnic position, and in itself is not an explanation of the differential impact of hazards. Also, although it may be true that most of the suffering in disasters is experienced by poor people, it may not be the case that all the poor suffer. Nor is it only the poor who suffer; the impact of hazards may well be a factor in creating newly impoverished people (in the sense of loss of assets or access to a livelihood) from those who previously had employment or were endowed with at least some resources (including perhaps land, animals and other means of production).

Although it is likely that those who own more means of production are likely also to be less vulnerable physically (they are likely to have a more substantial house, less likely to collapse and lead to drowning and injury), this is not always the case. It would be wrong to deal with disaster vulnerability by simply using poverty (measured by both income and assets) as the main factor explaining a disastrous outcome of a hazard. It has to be recognised that floods redistribute assets according to pre-existing patterns of vulnerability and opportunities, so creating poverty in new sections of the population and not just striking those who are already poor

There are therefore different levels or degrees of vulnerability outside of the variations in income. So there will be different intensities of disaster as well, reflecting the high or low level of vulnerability of the people affected by a hazard, including both the protection granted by self or society (the extent of success in preparation and mitigation of the

hazard itself), and the livelihood's strength. This conceptualization avoids the danger of the tautology of defining vulnerability as simply being the condition of people who suffer in a hazard strike.

Disasters should not be seen as unusual, extreme events. They should be seen in the context of normal economic and social systems, and the manner in which these generate patterns of differing access of people to livelihoods and different levels of protectedness to hazards. The following section illustrates this, and using floods as an example builds up a set of categories which could be used in other hazard contexts.

2 .1 Vulnerability and flood disasters in the Third World

The environmental hazard which annually affects more people than all others (excluding epidemic disease), especially in the Third World, is flooding (Ward 1978; UNDRO 1978: p.1).[3] Floods are the most widespread of all hazards, and may even affect places which at other times are prone to drought. They are destructive of life not only through drowning and direct injury, but also associated diseases and famine. But their impact is also disastrous because of the disruption and destruction they cause to livelihoods. The loss of assets or ability to work, of land and animals or of injury and illness, may be felt for many months or even years after the inundation has subsided. Any deaths which occur after such a time-lag are unlikely to be linked to the flood.

Some flood hazards are entirely a product of the natural environment. But this is not the same thing as saying that disasters which appear to be caused by floods are natural disasters. Disasters occur when people and their livelihood systems are vulnerable to such hazards, and a disastrous outcome should not be regarded as automatic. Vulnerability is a product of human-created environments which locate people and their livelihood systems in hazard-prone places, and human-created economic and social systems which allocate societies' resources to the detriment of some groups and in preference for others.

Flooding may be associated with famine (as for example in Bangladesh in 1974), and this may be more significant as the cause of death. Even where flood disaster does not extend into famine, the impact of the deluge on many people's livelihoods is at least medium-term disruption and probably hunger for some groups of people. Usually long-term vulnerability is increased, so that starvation is a more likely outcome from the next hazard-strike. Land and other assets may be lost or have to be sold. If the next flood reduces wage-earning opportunities (for instance for agricultural labourers when there is no harvest to be weeded or gathered), the associated higher food prices in the markets may lead to starvation for some even when there are adequate food supplies around (Crow 1984).[5]

2.2 Floods and known risks

There are few flood hazards which are not known about as a result of prior occurrences of similar events, although this is made more complicated by the different return periods (the average number of years gap between floods of a given magnitude occuring). As with other natural hazards, there are trade-offs in some economic systems between the livelihood benefits from inhabiting a risk zone, and the potential disastrous consequences

of the hazard itself. The most common gains are in farming on flood-plain alluvium, the land-cost advantages of industrial and urban locations on flood-plain sites, and enhanced fishing opportunities derived from the nutrient-rich waters brought to ponds, lakes and rivers by fresh-water inundation. In this sense, human action through settlement patterns has created the flood risks, though there are many variations in the degree of vulnerability of different sections of a population.

But there are also floods which might almost entirely be attributed to human action. With these, the hazard may arise downstream because of the supposed benefits to livelihoods from economic activity in other upstream places, sometimes far distant from the flood-zone itself. The most prominent examples of such problems are those produced by flood-control measures which shift the surplus water problem elsewhere, or of dams built (whether or not to control floods) to inadequate standards or on unsafe sites which collapse and cause flash floods.

There is also the issue of human intervention through deforestation, which results in the change of rate of flow of water into river systems This generally increases the risk of flooding downstream, as a result of both the increased discharge of water itself (which may overtop river banks), and the augmented load of silt and debris carried into rivers from the less-protected soil. The eroded material carried by the water reduces the river channels' capacity to transport water away. In upland areas themselves, sudden landslips and soil movements, some of which may be associated with deforestation, can lead to stream-damming and floods of farmland and villages. The mechanisms some people use for dealing with their 'normal' poverty and vulnerability can induce them to follow practices like deforestation which may increase flood risk for themselves and for millions of others in distant downstream areas.

2.3 Disastrous outcomes for vulnerable people

Understanding how disasters happen in the context of floods, requires analysis of the various patterns of vulnerability generated by different economic and political circumstances [6] These may then be linked to the bundle of factors which make up the livelihood and protectedness components of vulnerability measures, and used as a means of identifying the people at risk in flood-prone areas.

2.4 Mortality, morbidity and injury

Floods are not only the most widespread of natural hazards, likely to affect more people in more parts of the world than any other. They also lead to the greatest loss of life, immediately through drowning and fatal injury and through illness and famine.[7] Others may die later, never to be counted as victims of the deluge, in the deepened vulnerability of those whose livelihoods suffer a further downward twist of the spiral.

In a wide range of Third World countries, floods frequently lead to large numbers of deaths. Flash floods are particularly hazardous, because of the combination in many regions of people in vulnerable locations where this risk is not offset by precautions or warning systems.[8] Extreme events with long or unknown return periods are understandably difficult to anticipate. But many upland regions of the world, where there

is the risk of flash-floods with much shorter return periods, precautions ought to be possible.

Combination floods in which there is a coincidence of riverine inundations with heavy rainfall and/or coastal storms are also much more disastrous than ordinary slow-onset floods. In China, effective flood evacuation and follow-up organisation in recent decades, has reduced mortality considerably. Sichuan (Szechwan) province in south-central China experienced a river/rain inundation of gigantic proportions in July and again in August 1981. It affected nearly 12 million people and over 800,000 hectares of farmland (about 7 per cent of the sown area). The number killed was put at 920, low for a region of such high population density. Both the scale of the flood hazard in China and the history of attempts to deal with it seem extraordinary. Although such inundations still occur, events in which hundreds of thousands would die, especially in the valley of the Huanghe (Yellow River), seem to be in the past.[10]

Aside from the many casualties which can be caused by flooding brought by the impact of tropical cyclones on low-lying coasts, the highest direct mortality figures appear to result from rapid-onset deluges. These may be caused by tsunami (so-called tidal waves, caused by undersea volcanic or earthquake activity) as well as flash floods. Slow-onset riverine inundations of flood plains result in lower direct casualties (and these often more from building collapse, other injuries and snake bites than from drowning), but to enhance the risks of disease and malnutrition in the months or even years following.

This pattern is also recognizable in combination (riverine and rain-fed) floods like those which led to the 1988 Sudan disaster. This affected worst of all the millions of people already refugees from civil war and famine in the south of the country. Many were not prevented by the authorities from settling in low-lying, flood-prone land around the city of Khartoum. Bangladesh experienced immense slow-onset floods for two years running in 1987 and 1988, on top of the devastation of 1984 and 1974. These had in any case increased many peoples' vulnerability, as have the occasional tropical cyclones which have struck some areas as well.

Increased risk of disease such as cholera and dysentery arises from sewage-spread and the contamination of drinking water, while the incidence of malaria and yellow fever grows from the multiplication of insect vectors in the stagnant water which may remain lying about for months after an inundation, often held back by raised structures like roads and railways which have inadequate or unmaintained ducting for the return flow of water back to river channels. In addition, respiratory illnesses often become more prevalent, and take a toll especially among very young children and babies, and the elderly. Disease itself when not fatal, or injuries caused in the flood (e.g. by building collapse) are important factors in the perpetuation of vulnerability and its extension to new groups of people. The sick and injured usually cannot work, and the family's loss of their labour, especially during attempts to recover after a hazard strike, can be an element of the disaster.

There are insufficient surveys to know much about what actually happened to people after floods strike. An idea of the pervasiveness of morbidity and disablement problems is given

by a 1980 sample survey in Pakistan of rural settlements in the Ravi valley. The people interviewed were asked about their experiences in three years in the previous decade in which floods were particularly bad. Of the families questioned, between 43 and 57 per cent of members fell ill after floods, and 'at least one member of every family is bed-ridden throughout the coming season' (Sikander, 1983, p.102). Pakistan regularly experiences flooding affecting around 700,000 people a year, though in bad years (like those of 1971, 1975 and 1979 investigated in the survey) between three and six million were affected.

The health problems are particularly highlighted in studies of floods brought by El Nino's 1982-83 impact, not because they were especially bad compared with other regions of the world, but because again there are valuable survey results.[11] In Ecuador, many rural people fled to towns and cities, optimistic of conditions there when the waters failed to subside in the countryside. They took with them malaria, leading to the infection of urban areas previously cleared of the disease. The floods greatly increased the number of cases of malaria anyway. Despite massively increased insecticide sprayings, the number of cases rose in 1983, and even more in 1984, to levels ten to twenty times those of previous years (depending on location) (Cedeno 1986).

To the south, in neighbouring north Peru, a study of government health centres showed morbidity rates up by 75 per cent for respiratory and 150 per cent for gastro-intestinal illnesses in the first six months of 1983 (compared with the same period the previous year when El Nino had not been extreme) (Gueri et al, 1986). These illnesses led to a large increase in death rates.[12] The centres surveyed covered a population of only 630,000, the number of deaths in the first half of 1983 was 6,327 compared with 3,226 in the same period in 1982.

This 'unseen' aspect of the flood hazard, which may be repeated in many other inundations where such detailed figures are not available, give deeper significance to the notion of flood disaster. None of the illnesses were unknown; they were endemic in the region. Their much-increased incidence was a predictable result of the deluge, and ought not to have produced such high mortality But they struck a population many of whom were already very vulnerable owing to existing economic and social conditions. The 1982-83 El Nino was of intensity unknown for over fifty years. As with other hazards that have a long return period, is it fair to consider human factors in the causing of the associated disaster? There is a strong argument here that a 'collective memory' is needed for hazards with a long return period, and that it ought to reside with government at local and national level, if it is unreasonable for it to be held by the community.[13]

2.5 Livelihood disruption

While death, illness and disablement lead to a reduced capacity for work in affected families, there are other impacts on peoples' livelihoods which make some vulnerable and others possibly enriched. Not all groups in flood areas are necessarily disaster victims. The flood may have its impact on different social and economic groups in a more or less severe manner. In floods it is of course true that much property is damaged, destroyed or swept away But even flooded land can be sold by a destitute farming family to buy food,

despite its likely low prices arising from many others making such 'distress sales' at the same time. The same applies to other goods, and so there are beneficiaries of the disaster who can accumulate land or other assets at depressed prices. Others may benefit from their possession of food stocks, selling at higher prices in the aftermath. Still others may have saleable goods or services on which they can thrive, perhaps trading in drinking water by virtue of owning a boat to carry it around.

Each person or group's 'bundle' of property and assets (including land and animals for farmers, or boats and nets for fishers) and economic connections with others in or beyond the group, may be lost, enhanced, disrupted or reinforced in a number of permutations. This sort of disaggregating approach to the impact of hazards shows that although possibly a large majority of people are made worse off, floods may not be a disaster for everyone. They operate under the influence of rules and structures derived from the existing social and economic system, but modified by the distinct characteristics of particular flood strikes and patterns of vulnerability.

2.5.1 House and domestic losses

Poor people in most third World countries are rarely insured. The loss of the home is a major livelihood setback, not because it is necessary for earning a living (though it often is), but because of the burden on limited finances in providing some replacement. This cost may not be in terms of cash outlay, but instead the loss of time which would otherwise be used in livelihood/earning activities.

Many simple household items may need replacing, such as cooking pots and water vessels. This also diverts time and labour from livelihood activities, or consumes limited reserves. There is no need to provide a list here; the point is evident, that recovery is not just about the hardship of loss, but also the disruption of normal livelihoods. In a sense then, uninsured people with no reserves of cash lose twice in a flood disaster: they lose the goods many of which are essential to life, and they lose the time which they have to spend in work to replace them, which is therefore not so available for survival (in food-growing or wage-earning). Having reserves or insurance means being able to return more immediately to normal livelihood activities.

2.5.2 Crop and animal losses

Other losses may be directly disruptive of a person, family or larger group's livelihood. Standing crops are a property-loss to the farmers who own them (and for the poorer families this is perhaps the most serious aspect of flooding). In many areas of the world, there is an unhappy coincidence of the season in which floods are more likely and the crops ripening for harvest. However, crops in some parts of the world are well-adapted to expected levels of flood. Many thousands of varieties of rice have been developed indigenously in south and south-east Asia. They include types which grow so rapidly they can keep pace with rising flood water, and the floating varieties planted in many areas, selected to be grown with floods.[14] But even these will succumb to inundation under some circumstances, along with non-adapted crops

For larger land owners, there would normally be a need for labourers in fields whom they no longer need to employ when they are flooded. Massive losses of wage-earning employment on the flooded fields may be disastrous for those families which rely for a large part of their livelihood on such income-earning opportunities as ploughing, weeding, irrigating and harvesting. The impact of crop loss on better-off land owners is likely to be much less disastrous depending on the amouht of the families' reserves.

The length of time that water remains on the land may also affect the prospects of the subsequent normal planting, or of a 'catch crop aimed at recovering some of the losses. The difficulties which follow crop-loss vary depending on the existing level of vulnerability of the affected people, from an immediate deepening of hunger through to a reduction of cash or material reserves. Whether is the loss of food crops for subsistence or sale, or of other cash crops, the flood-affected people are very likely to have a reduced resistance to the impact of the next hazard.[15]

Animals may be swept away and drowned or injured, and their loss to those families which used their produce for subsistence or sale suffer in a manner similar to that of crop loss. But animals are often the main source of draught power and/or transport for significant sectors of the rural population in many parts of the Third World. In Sikander's study of Pakistan, the surveyed villagers reported 35 per cent losses of their animals. So the risk of their death or injury in floods adds a further measure of vulnerability. Recovery is often not to the same level of well-being as before the hazard struck.

2.5.3 Loss of land

The necessity to give up land through distress sales during times of hardship associated with floods has been mentioned already It is a part of the process by which productive resources are redistributed in the Third World countryside from the vulnerable to better-off groups. But in floods there is also the physical process by which land is destroyed by the erosive capacity of the flood streams, and recreated in the areas where silt is deposited as sediment-laden waters are slowed down.

Flooded rivers are by definition flowing beyond their usual banks. Their route across the countryside, if unconstrained by human constructions, will be through the lowest-lying land, which provides new routes as gravity pulls the deluge down the gradients. Rivers carve new channels in this way, often miles away from their previous course. The distances of such channel migrations can be large even for relatively small rivers like the Kosi in Bihar, north India. There the highly braided (split) channel has moved westward across a hundred kilometer-wide tract of country for the past 250 years at least (Ives and Messerli 1989). In the Yellow River floods of the last century, its main channel has migrated hundreds of miles from the north to the south and back again. At times it has joined up with the Yangzi and discharged near Shanghai; at others its mouth has been near Tianjin (Clark 1982). The two cities are a thousand kilometres apart.

Those who lose land is lost in part or in total in this process are unlikely to have access to the compensation of land to replace it, even should they get other forms of aid. Yet others may find that fortuitously the river has abandoned a channel near them, making it possible

in time to colonise the waterlogged land. However, the more powerful and already better-off classes are more likely to gain control of such new land, as happens in Bangladesh (Elahi 1989).

But land is 'lost' in other ways too. Depending on the speed of the flood waters at a given place, the soil itself may have been carried away. Generally though, as flood waters spread out across the landscape, they slow to a pace at which they can no longer carry their suspended load of silt and sand. They then deposit the sediment on top of the earth, and the characteristics of it can vary tremendously. In some regions it is usually beneficial in replenishing minerals which are useful to plant growth and otherwise improving fertility; the nature of the silt deposited is benign. But this is not always the case. The size of deposited particles may be much larger, covering extensive areas with infertile sand or gravel. The mineral content of the sediment may be too saline or alkaline, rendering the ground toxic to plants.

Depending on the combination of these different factors (water speed and consequent erosion or deposition, the size of deposited particles and their chemical characteristics), the land left behind can be enriched and newly fertilized by the layer of deposited silt, or more barren and less productive, with a crust of inferior sand or minerals which inhibit plant growth. Flash floods in Rajasthan (west India) are likely to produce the latter situation (Seth et al 1981), in a region which is more normally facing up to problems of drought rather than inundation. The Kosi's floods in north Bihar also normally deposit a layer of sand over agricultural land, rendering it useless for fifty years (Lyngdoh 1988).

In Bangladesh it is more likely that flooded land is enriched by the new layer of silt cast on it by the floods. Further downstream in that country, the waters of the Ganges and Brahmaputra arrive at the Bay of Bengal laden with silt, are stilled by the sea and add new material for the expansion of the delta. This new land, often in the form of islands called chars in the middle of the many channels of this complex river system, is quickly squatted by poor and landless peasants from elsewhere who otherwise have no means of subsistence. Their precarious existence on the edge of this watery boundary-zone is being aided by NGOs in some places by the building of protected high-points which offer some security during cyclones and storm surges.

Poor and landless peasants in Bangladesh and other countries often become victims of floods through loss of their livelihood rather than life or home. Farmers with sufficient land to require the use of wage-labour will not need to employ others if the harvest is destroyed by flood. If those who normally would be employed have no alternative, then their normal 'entitlements' to a means of subsistence suffers disruption. They may end up in towns or cities seeking relief, and may even be forced to resettle on the chars or dikes.

2.5.4 River-based livelihoods

Water itself is an important part of the resource or livelihood rights of many people likely to be affected by floods. Rivers are crucial for livelihoods based not just in agriculture but also on transport, trading and fishing. Channel migration may disrupt these livelihoods too, creating havoc among whole sections of a population.